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THE

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AUTOMATIC MACHINES.

ONE hears from time to time a good deal of criticism of English methods in regard to workshop practice. Some of the criticism is founded on good solid fact, but a very large proportion of it, and practically all that which appears in the daily press, is founded on sheer ignorance of facts and of matters of engineering fitness. Foremost in this mass of criticism we have noted the question of automatic machines of the capstan order. These machines make bolts, studs, valve pillars, knobs, nuts, and an immense variety of other pieces from rods which pass through the hollow spindle of the machine, and are turned to shape and cut off complete finished articles at very small cost in labour, but with a considerable waste of material, *e.g.*, in the case of bolts, which are made from hexagon rolled steel, of the shape of the head, the body of the bolt being simply turned down. For small knobs, nuts, small bolts, studs, and similar things the automatic machine is very suitable, but it is often used to make articles which ought not to be made out of the solid bar. For example, so far as regards shape, the pillars of a stop valve are quite suited for automatic work, and so are the eccentric rod bolts of an engine; but it is not right that either of these articles should be made thus. The inside of a mild steel rod is not so good as the outside, and in turning down bolts or similar articles from the solid bar the best of the material is cut away, and the result is a bad piece of work. The heads of bolts so made are very liable to fail.

Of the mild steel rods for automatic work that come into this country we find that much of the American product is very bad and variable. One bar will be sound and tough, the next will be short and rotten, and will break like cast-iron; such material is not safe stuff from which to make bolts by which anything important is attached. Care and intelligence are needed in selecting the jobs for automatic machines. A plain screwed stud, for example, is quite suitable. A large bolt is just as unsuitable. Steam engines and other machinery can be made of correct form and to look well with all parts of nice and correct shape, but the work may be absolutely rotten in respect of the material employed and of the mode of construction.

Let us take such details as connecting-rod bolts and valve pillars that are made on automatic machines in America, and see how they are made in England. Probably the Horsfall forging machine is used. A white-hot bar of iron is thrust in the machine. Two laterally-moving dies advance and grip it fast. An end plunger advances and upsets the head, which is forged to hexagon or other shape by laterally-moving side hammers. A shears cuts off the finished length. The process is rapid, there is no waste of material, one man or boy alone is needed, and a sound bolt is the result, that can be depended upon not readily to fail. The forged bolt is turned rapidly to size in a vertical machine and screwed in a cheap machine, and its head is shaped by a special broaching machine. It is

questionable whether there is much difference in cost between the English and the American system, and there is no comparison between the qualities.

There is a large trade done in America in portable engines, which are sold in competition with the East Anglian article. Compare the two machines. An English portable engine has substantial cast-iron saddles rivetted to the boiler. These are planed level by setting the whole boiler on a planing machine, and planing off the two saddles. The surfaces are thus made true and parallel with each other. On these saddles the cylinders and crank brackets are bolted. In the American article the cylinder is simply attached to the boiler shell by studs screwed into the latter. Parts that are forgings in the English engine are castings in the American; cast-steel becomes cast-iron; gun-metal cocks become soft-brass automatic work, and so on, and our friends of the Daily Dirge have not the knowledge except to write the English machine down as clumsy and needlessly heavy, and so on. The truth is that people have allowed themselves to be scared by the shouting of the Americans. Sometimes we think that the Americans really do believe that all their productions are superior to any others. We concede to them much that is good, many things in which they have excelled, but, taken all round, their products are simply sacrificed to the vice of rapid shop work. A manufacturing engineer informs us that he has had many American tools, but that they all wear out very rapidly. Although he had only had some of them for about three years, he was compelled to replace the whole of the beds. Scraper marks in American cast-iron are all gone in six months, and of one class of machine — he named several makers of it—he avers he will not have another in his shop. Good designs—and no one can say that many of the American machine tools are not well-designed and handy tools—are simply ruined by cheap, soft material. It is not a question of scrapping in five years, but of being past accurate work in 12 months.

Again, what English crane maker will make the hook of a big crane except of the best forging he can produce? We are told that American overhead shop travellers have cast hooks—not cast-iron, we hope, but cast. American methods, so much called for, are not wholly applicable to English work. Americans do not secure interchangeable parts any better than the most ordinary English shop, and though we would have our manufacturing engineers wake up and be on the alert for what is new and good, we would warn them not to give way to the panic of cheapness, and make stuff that is not reasonably durable. The great scrap heap gospel is very good in its place, but there is no doubt it has been very largely preached from motives akin to those of the Irishman who killed the sick pig to save its life. When a machine tool is likely to be irretrievably worn out at five years of age it is just as well to persuade the owner to scrap it at four years as obsolete.

Obsolete is a fine word. So is scrap. They are both used as a counterblast to that detestable durability of things British that still holds the best markets for British goods. If British makers care to do it, they can drop weight and durability and all these British vices as easily as the proverbial crow dropped its bit of cheese to the waiting fox below.

Electrical Exhibition and Meetings.

A SERIES of interesting and consequential events in connection with electric traction will be commenced on Monday next, when the second international tramways and light railways exhibition is to be opened at the Agricultural Hall, Islington, by the Rt. Hon. Gerald Balfour, M.P., President of the Board of Trade. The exhibition will remain open to the public from July 1st to 12th, and will be visited by thousands of British and Continental tramway and electrical men who are anxious to keep themselves informed as to the things that are new in electrical traction machinery equipments and materials. The congress of Continental tramway officials promises to be perhaps the most interesting item in the whole programme, and our tramway friends will not be lacking in anything which may render this brief season of fraternising profitable and congenial to their foreign guests. It will be remembered that the idea of the present visit of Continentals was set on foot by Mr. R. H. Scotter two years ago, when attending the Paris Tramway Congress. The excellent reception accorded to that gentleman as British representative calls for most cordial feelings on our part as hosts. With the exhibition and congress, the Kensington conversazione on July 1st, and the conference of the Incorporated Municipal Electrical Association, which opens on Wednesday next, electrical engineers have plenty to think of just now besides the Coronation.

The Workmen's Compensation Act.

AMONGST the batch of cases which have recently occupied the attention of the Master of the Rolls and other members of the Court of Appeal, there is one which stands out pre-eminent in importance so far as the electrical world is concerned. We refer, of course, to the case in which a tramway was held to be an "engineering work" within the meaning of the Act, with the result that those who are employed on the construction or repair of a tramway are brought within the provisions of the Act. The facts of this momentous case were shortly these: a man was employed by the London United Tramways, Limited, to repair a portion of their line between Hanwell and Acton. It appears that a portion of the company's system is in strictness a "light railway"; but nothing turned upon this, and there was nothing to show whether the accident in question happened upon the tramway or the light railway. By Sub-Sec. (2) of Sec. 7, a railway within the meaning of the Act is defined to be the railway of any railway company to which the Regulation of Railways Act, 1873, applies, and it includes a light railway made under the Light Railways Act, 1897; while "railway" and "railway company" have the same meaning as in those Acts. "Engineering work" means any work of construction or alteration or repair of a *railroad*, harbour, dock, canal, or sewer. The County Court judge held that "railroad" was synonymous with "railway," and that it did not include a tramway. He accordingly dismissed the application. On appeal this decision was reversed, the Master of the Rolls saying:—"The Legislature has introduced the word 'railroad,' a different word from 'railway,' which they had used before. There is no vehement presumption in this Act that the Legislature when they used different words meant the same thing. . . . The word 'railroad' is clearly capable of including tramway, and in itself it seems a good word for describing a tramway. . . . It seems to me to be clear that they intended to include a tramway and something else." One or two points call for observation in connection with this judgment. In the first place, no stress was laid upon the fact that the tramway in question was an electric

tramway; hence the principle enunciated in the case applies to every tramway in the kingdom, whether the same is worked by horses, steam, or other mechanical power. It is obvious that this involves a very material extension of the scope of the Workmen's Compensation Act; for the laying of a tramway in a thoroughfare involves the completion of a number of operations which cannot be said to be fraught with much danger to the workers who carry them out. The judicial interpretation which is given to the word "railroad" in this case opens up a long vista of litigation in the future.

An Ancient and Modern Combine.

Four cities in Greece, and later on a fifth, besides an electric railway, to be supplied from a central power station—is a sight for the gods! The Acropolis of Athens, with the Temple of Theseus, within sight of the new electric plant! The difficulties to be overcome in Greece were very great—no coal of a steam producing quality, nor any available water power—and yet private enterprise, backed by American manufacturing and technical skill, has developed the electrical industry in this ancient part of the world to a surprising extent. One of the great difficulties in the way of the manufacturers in Greece, has been the heavy cost of coal imported from abroad, and electricity is now introduced to supply the necessary power, and do in Greece what private enterprise is endeavouring to accomplish in England, in spite of the opposition of municipalities and legislative obstruction. The central power plant has been constructed at New Phaleron, and will supply Athens (five miles distant), Piræus, besides the ancient and modern Phalerons, and eventually Cephisia. It is equipped with 8,620 H.P., and consequently ranks among the most important Continental electric supply stations. The enterprising Thomson-Houston Company supply the system. It is interesting to find the ancient Greeks adopting the most modern system of electricity supply. There is a large power station to generate current for long-distance transmission, instead of putting down isolated works for provision of the limited areas of single towns, and Athens can already boast of a demand for electric light far beyond that of many of our large towns, viz., 40,000 10-C.P. incandescent and 260 arc lamps, and with the supply of power on much more favourable terms than have been possible with steam, the manufacturing interests will be materially improved.

An interesting and beautifully illustrated account of the progress of "Electricity in Greece" was recently contributed to *Cassier's Magazine*—by Mr. Frank W. Jackson, of Patras—who thus moralises upon the change which the electrical engineer is introducing into the most ancient cities of Greece, he says :—

> As one stands in the shadow of one of the tall chimneys of the plant already completed, with the Acropolis and the temple of wingless Victory silhouetted against the afternoon sky, and the Mediterranean behind him lapping the sands in the same dignified way it did for Theseus of old, one must prick himself to make sure he is not dreaming. The din of carpenter's hammer, the rasp of the mason's trowel, the rush and roar of the suburban train on one side, and the clatter of the street car on the other, all these are marks of materialism, the stamp of present-day progress, which at first thought, seem out of harmony with their classic surroundings But the most able statesmen of the old school were, after all is said, the most practical, and dreamed dreams, twenty-three centuries ago for their country, which are but being fulfilled to-day. And if Themistocles, to whom the Piræus was as the apple of his eye, could come upon the scene, taking his bearings from the Acropolis, which he would still recognise, he might, perhaps, be heard to say, "I told you so; I told you so."

NOTES ON THE RESISTIVITY OF TRACK AND COLLECTOR RAILS AS AFFECTED BY THE CHEMICAL COMPOSITION, &c.

By SYDNEY WOODFIELD.

The conductance of steel depends on the chemical constituents of the metal, as well as on its physical properties, and it is noteworthy to remark that the conductance is reduced considerably by a very small increase in the percentage of another element alloyed with it, this being the case even when a metal having a higher conductance than the steel itself is the alloy. There appears to be very little information regarding the conductivity of steel having different physical properties. One would expect the specific resistance of an ordinary running rail to increase after being some time in use, owing to the re-arrangement of the fibres, and as to whether the fact that a rail is carrying current continuously materially affects the problem, is a subject of *considerable* scientific interest. The various constituents of ordinary rails and their effects are briefly set forth below.

Carbon produces hardness, but it is liable to make the rail brittle, unless extreme care is taken in the manufacturing process, and in the proportioning of the other chemical constituents. The specific resistance rises rapidly with an increase of carbon.

Manganese is really necessary during the blow in the converter for certain chemical purposes, and produces ductility in the rolling process, but in excess causes crystallisation in the rails, and also causes the metal to flow under traffic. Manganese also largely increases the specific resistance.

Silicon tends to produce a denser and more compact metal, and helps toward small crystallisation and fluidity.

Sulphur makes the metal seamy, and is a very objectionable impurity.

Phosphorous is also objectionable, producing brittleness, but it has been stated by the Commtttee appointed by the Board of Trade to inquire into loss of strength in rails, that phosphorous may exist in at least two different forms, one of which is comparatively innocuous, hence, in a broad sense, brittleness does not depend on the total amount of phosphorous present.

Against this, however, Mr. Dudley, of the New York Central and Hudson River Railroad, states that he has not been so fortunate as to find a part of the phosphorous "innocuous" in the rails, and he further states that rails having 0·08—0·1 per cent. of P have broken more frequently in the track than those having from 0·05—0·06 per cent. of P.

Of late years the tendency has been to increase the percentage of carbon in order to obtain a hard and tough rail. Mr. Parshall (Institution of Electrical Engineers) states that English rails a few years back would commonly contain :—

Carbon	0·25—0·35 per cent.
Manganese	0·8 —1·0 per cent.
Silicon	0·05 per cent.
Phosphorous	0·06 per cent.
Sulphur	0·06 per cent.

Comparing this with the figures given by the International Association for testing materials, viz. :—

Rail weight per yard in lbs.	Per cent. of			
	C.	P.*	Si.*	M.
50—59	0·35—0·45	0·1	0·2	0·7 —1·0
60—69	0·38—0·48	0·1	0·2	0·7 —1·0
70—79	0·4 —0·5	0·1	0·2	0·75—1·05
80—89	0·43—0·53	0·1	0·2	0·8 —1·1
90—100	0·45—0·55	0·1	0·2	0·8 —1·1

* Shall not exceed.

We see that the percentage of carbon has increased by a considerable amount. Even the above figures do not reach the limit, as the New York Central and Hudson River Railroad specify for their 100-lb. rail 0·65—0·75 per cent. of carbon, and the Delaware, Lackawanna and Western Railroad have laid down short lengths of Harveyised steel rails; by this process more carbon is absorbed by the head of the rail after manufacture, and, according to Tratman, at

$\frac{1}{16}$ in. in depth an analysis showed 0·76 per cent. of carbon and 0·42 per cent. at $\frac{1}{8}$ in.

H. Le Chatelier (*Comptes Rendus de l'Academie des Sciences*) gives the following table showing the increase in resistance with increase in percentage of carbon.

The specimens on which the experiments were made were bars 20 centimetres long and 1 centimetre square; they were annealed several hours at 600° C.

Resistance per C C in microhms.	Composition.		
	C	Mn.	Si.
10·0	0·06	0 13	0 05
12·5	0·2	0·15	0 08
14	0·49	0·24	0 05
16	0·84	0·24	0·13
18	1·21	0·21	0 11
18·4	1·4	0 14	0·0
19 0	1·61	0 13	0·08

The resistance clearly increases with the amount of carbon; its increase is on an average of 7 microhms for 1 per cent. of carbon by weight, or 1½ microhms for 1 atom of carbon per 1,000 atoms of iron and carbon. An increase of 14 microhms for 1 per cent. of silicon by weight, or 7 microhms for 1 atom of silicon per 1,000 atoms of alloy. The author is led to the conclusions that in steel the silicon is not isolated in the form of a homogeneous mixture, solid solution or isomorphous mixture. The figures given in Table No. 1 also show the increase of resistance as affected by the chemical composition. Mr. Parshall further shows that the Dublin rails after 2½ years in service, and when tested in position, gave a resistance as compared with copper of 10·4, which is equivalent to 0·45 ohm as the resistance of 1 mile of 1 sq. in. section at 20° C., which corresponds on a 76-lb. rail to a resistance of 0·0295 ohm per mile of single track, or 0·0147 ohm per mile of double track. Mr. Philip Dawson, in his "Electric Traction" pocket book, gives the following table:—

SECTIONAL AREA OF RAILS AND CORRESPONDING COPPER BONDING FOR DOUBLE TRACK; AMERICAN EXPERIENCE.

Weight of rail, lbs. per yd.	Total sectional area in sq. in.	Equivalent in copper.			Approx. No. B.W.G. No. 0000.	Resistance per mile.
		Sectional area. sq. in.	Thickness.	Width.		
50	20	3 33	1	3·33	20	0 0121
60	24	4·00	1	4 00	24	0·0101
70	28	4·66	1	4·66	28	0·0086
80	32	5·33	1	5·33	32	0 0075
90	36	6·00	1	6·00	36	0 0067
100	40	6·66	1	6·66	40	0·0060

It must be borne in mind that in taking the resistance of a track already in position by sending through it a predetermined current and measuring the potential drop by means of the pilot wires does not give the true resistance, as current passes from the rails to earth and joins the rails at other points; thus the true resistance may be considerably higher than the apparent resistance found by this method. Mr. Parshall states that at Dublin on three different sections the apparent resistance was 61 per cent., 73 per cent. and 75 per cent. of the calculated resistance, the calculated resistance being taken from individual rails, taking into account an allowance for joints, fishplates, &c. In a recent test I carried out on a small tramway, I found that just over 20 per cent. of the current was leaking from the rails and joining again at various points. Unfortunately, Mr. Dawson does not state where and how the rails were laid in the table given above; in any case the resistance per mile appears to be remarkably low, and indicates that about 50 per cent. of the current was leaving the rails and returning by the earth. At Bristol the resistance as compared with copper of the 76-lb. rails is 10·5, which corresponds to a resistance of 0·451 ohm for 1 mile of 1 sq. in. at 20° C., assuming the specific resistance of copper as 0·68 microhm per inch cube at 20° C. These figures also given by Mr. Parshall compare very closely with the figures given for Dublin. The following are values given by American and Continental firms as representing standard practice:—

No.	Resistance compared with copper.	Resistance of 1 mile 1 sq. in. at 20° C.	Resistance per mile double track 100-lb. rails, 10% added for bonding.
1	11·3—12 5	0 485—0 535	{0·0·34 / 0·0148} ohm.
2	12 1	0·52	0·0 .43 „
3	11 8	0·506	0 0140 „
4	11·5	0·499	0·0138 „
5	12 3	0·53	0·0145 „
6	12·1	0·52	0 0143 „

The first column are figures given by the companies, and the second and third columns have been figured therefrom, on the assumption that the specific resistance of copper is 0·68 microhms per inch cube at 20° C. These figures are fairly high, the reason being a somewhat large percentage of carbon and manganese. The following data (given in the *Electrical Engineer*, New York, by R. L. Warner) is of considerable interest. The tests were made by the drop of potential method, and figures given are the resistance per mile of double track.

A.	No bonds, dry weather	0·7675 ohm.
B.	Bonded and cross bonded, dry ...	0 0797 „
C.	„ „ „ „ wet ...	0 0717 „
D.	„ with continuous wire, wet ...	0 0207 „
E.	„ „ „ „ dry ...	0 0254 „
F.	„ no continuous wire, dry ...	0·0577 „

In case "B" the track was bonded with iron wire of different sizes, principally No. 8 B and S gauge. "D" was bonded with No. 3 copper wire, rivetted to rails and soldered at each bond to a continuous copper wire of the same gauge; rails were cross-bonded every 200 ft. "E" was similar to "D," but bonds

TABLE I.—INFLUENCE OF CHEMICAL COMPOSITION ON CONDUCTIVITY OF STEEL. H. F. PARSHALL, FROM DAWSON.

Carbon.	Manganese.	Silicon.	Phosphorous	Sulphur.	Resistance compared with copper at 20° C.	Resistance of 1 mile 10 in. area at 20° C.	Resistance of double track 100-lb. rails per mile a. 20° C.
0 378	0 550	0·181	0 040	0·041	10 8	0·468	0·0117
0 446	0·568	0 188	0 046	0 044	11·1	0·486	0 0121
0 536	0 592	0 201	0 051	0 059	11·3	0·490	0 0123
0·568	0·608	0 204	0·053	0·061	11·4	0·495	0·0124
0·588	0·632	0·214	0 056	0 065	11 5	0·499	0·0125
0·610	0 650	0·220	0·062	0·071	11·1	0·560*	0·0126

* This figure should evidently be 0·522, assuming the resistance compared with copper at 12·1; if 0 560 be correct resistance compared with copper should be 12 95.

Last column is calculated from Mr. Parshall's figures.

TABLE II.—RESISTANCE OF ONE MILE OF TRACK.

Weight per yard.	Area single track sq. in.	Resistance per mile single track in ohms.	Resistance per mile of double track in ohms.	10 per cent. added for resistance of bonds.	
				Single.	Double.
70	7 × 2	0 0323	0 0161	0 0353	0·0176
75	7 5 × 2	0·0301	0 0150	0·0331	0·0165
80	8 × 2	0·0283	0·0141	0·0311	0 0155
85	8·5 × 2	0·0266	0·0133	0·0292	0·0147
90	9 × 2	0·0250	0·0125	0·0275	0·0137
95	9 5 × 2	0·0238	0·0119	0·0261	0·0130
100	10 × 2	0·0226	0 0113	0·0248	0·0124

NOTE.—Area of rail $= \frac{\text{weight per yard}}{12 \times 3 \times \cdot 284} = \frac{\text{weight per yard}}{10{\cdot}2}$.

Weight of a cubic in. of steel taken as ·284 lb. In above table area of rail has been taken as $\frac{1}{10}$ of weight per yard in place of $\frac{1}{10{\cdot}2}$ of weight per yard. Specific resistance of copper taken as 0·68 microhm per in. cube at 20° C., and resistance of steel compared with copper as 10·5.

soldered to rails as well as rivetted, and cross bonds at more frequent intervals. "F" was bonded with two No. 4 galvanised iron wires. It will be seen that in both cases the apparent resistance in dry weather is considerably higher than in wet weather, owing to the greater

leakage through earth in wet weather. It will be noticed that 10 per cent. has been added for the resistance due to bonding, gathering, &c.; this figure has been taken to represent conditions after a few years, and is about the figure found from actual tests. Of course, if tested immediately after bonding, the resistance taken over a joint, including conductivity due to fish plates, sole plate and bonds, may be less than an equivalent length of the rail. In designing a tramway, care must be taken that the potential drop in the rails must not exceed the limit of the Board of Trade, viz., 7 volts, and this must be taken with the distribution of cars in the worst possible condition. In some cases, however, it is perfectly safe to figure out for a

TABLE III.—RESISTANCE OF ONE MILE OF TRACK.

Weight per yard.	Area in sq. in. single track.	Resistance per mile single track in ohms.	Resistance per mile double track in ohms.	10 per cent. added for resistance of bonds.	
				Single.	Double.
70	7 × 2	0·0339	0·0170	0·0372	0·0186
75	7·5 × 2	0·0316	0·0158	0·0349	0·0174
80	8 × 2	0·0297	0·0148	0·0327	0·0163
85	8·5 × 2	0·0279	0·0139	0·0307	0·0153
90	9 × 2	0·0264	0·0132	0·0290	0·0145
95	9·5 × 2	0·0250	0·0125	0·0275	0·0137
100	10 × 2	0·0237	0·0118	0·0264	0·0130

NOTE.—Area of rail $= \frac{\text{weight per yard}}{12 \times 3 \times 0{\cdot}284} = \frac{\text{weight per yard}}{10{\cdot}2}$.
Weight of cubic in. of steel taken at ·284 lb. In above table, area of rail has been taken as $\frac{1}{10}$ of weight per yard in place of $\frac{1}{10{\cdot}2}$.
Specific resistance of copper taken as 0·68 microhm per in. cube at 20° C., and steel taken as 11 times that of copper.

drop of about seven volts with maximum load, as the actual drop will be considerably less, owing to leakage through earth; thus with 7 volts drop calculated, and assuming 25 per cent. leakage, the apparent drop would be only $5\frac{1}{4}$ volts. On a light railway using Vignoles rails spiked to wooden ties, the leakage would be considerably reduced, and it would be, therefore, unsafe to allow for leakage. Of course, the Board of Trade regulations were drawn up to limit the leakage as far as possible, and, therefore, the calculated drop should be kept down to a minimum. Tables 2 and 3 give resistances of tracks, &c., as calculated.

With third rails we have not to take into consideration the mechanical strength and physical properties to such an extent as with the running rails, since, of course, there are practically no stresses or strains set up as there are in the actual running rails.

We are, therefore, at liberty to so proportion the chemical constituents as to give the least resistance, providing we comply with the proportions necessary to give the required strength and hardness, bearing in mind, however, that certain constituents are required in the process of manufacture. It is interesting to compare the following table with those given before; these are actual figures taken from samples, some of which are being used on present day electric roads:—

—	Percentage of					Resistance compared with copper.
	C.	Mn.	P.	S.	Si.	
1	0·03	0·33	0·052	0·045	—	6·92 average
2	0·09	0·08	0·015	0·03	0·011	6·6
3	0·045	0·02	0·04	0·03	—	6·6
4	0·12	0·25	0·06	0·05	—	6·9 average
5	0·05	0·27	0·05	0·035	—	6·8

The average resistance compared with copper appears, therefore, to be 6·8 (6·76), or a little over one-half that of ordinary steel as used for running rails. The rail No. 1 in the above table was tested after laying, and the ratio compared with copper came out at 6·93, thus showing that the bonding had not appreciably increased the resistance; this test, however, was carried out soon after the laying, and it is highly probable that the resistance would be considerably increased after a few months' of running. On the Waterloo and City Railroad Mr. Jenkin states that the resistance per 1,000 yards was found to be 0·051 ohm taken with the drop of potential method; this gives approximately 0·09 ohm per mile, and taking the sectional area as $4\frac{1}{2}$ sq. in., the resistance, as compared with copper, figures out at 9·35. Even including connections, &c., this figure appears to be high, and does not compare at all favourably with 6·93 given

TABLE IV.—RESISTANCE OF ONE MILE OF THIRD RAIL.

Weight per yard in lbs.	Area in sq. in., one rail.	Resistance per mile of rail in ohms.	Resistance per mile, two rails in parallel, in ohms.	10 per cent. added for bonding.	
				Single.	Double.
70	7·0	0·042	0·021	0·046	0·023
75	7·5	0·039	0·019	0·043	0·0209
80	8·0	0·0366	0·0184	0·0404	0·0201
85	8·5	0·0344	0·0172	0·038	0·0188
90	9·0	0·0325	0·0163	0·036	0·0178
95	9·5	0·0308	0·015	0·034	0·0165
100	10	0·0294	0·0147	0·0324	0·0162

Area of rail taken as $\frac{1}{10}$ of weight per yard in place of $\frac{1}{10{\cdot}2}$ weight of cubic inch of steel taken as 0·284 lb. Specific resistance of copper taken as 0·68 microhm per inch cube at 20° C., and steel taken at 6·8 times that of copper.

for the Central London Railroad. On the Manhattan Elevated a 6 in. T contact rail is used weighing 100 lbs. per yard; the chemical composition is given as follows:—
C = 0·073 %, Mn = 0·34 %, S = 0·073 %, P = 0·069 %,
and it is stated to have about eight times the resistance of copper. The figures in Table No. 4 have been worked out, taking the average ratio of steel to copper at 6·8 from the above table, and it appears to be fairly correct for lines at present running where 10 per cent. has been added on for increase of resistance due to bonding, &c.

WIRELESS TELEGRAPHY AND SUBMARINE CABLES.

BY EMILE GUARINI.

SYNTONY, as it is called, lends itself to a marvellous extent to the realisation of multi-communication in submarine telegraphy.

We will not here explain the comparatively complicated mechanism of syntony, for it would lead us beyond the limits of this article, but we will return to this subject when we discuss the secrecy of despatches sent by wireless telegraphy; we will confine ourselves to saying in a few words what it really is, roughly speaking, *i.e.*, disregarding several coefficients that should be taken into account. The waves have nodes and ventral segments for tension as well as for intensity. A receiver or coherer is syntonised when it is placed at a ventral segment of the tension, or, better still, between two ventral segments of opposite signs, for instance, by using a bridge. Hence we see that if a coherer is constructed to work when we apply to its terminals a difference of potential e, *i.e.*, the difference we get between the ventral segments (of tension) of contrary signs, for instance, it will not work for other intermediate points (where the tension is less than e). Moreover, if we have several coherers working for one difference of potential e, and if by means of a current with a tension E, we produce waves of different lengths, we can see how easy it is to realise multi-communication. All that is required is that the ventral segments of the tension of the different waves shall not coincide, and that each coherer shall correspond with its particular ventral segment.

The high frequency (Hertzian) waves are all adapted to the realisation of syntony; with their short length it is easy to realise the conditions above mentioned. In order that the same wire may be traversed by waves of different lengths, as in the last model of the Marconi apparatus (English patent, No. 7,777, April 6th, 1900), the inductive method, employed by Blondlot, Turpain, &c., must be used. In fact, if a wire is connected directly with several oscillators, the oscillators will be connected with one another and will

form, so to speak, a single discharging circuit. The "inductive method" therefore enables the period of the oscillator to be rendered to a certain extent independent of the electric constants of the wire, which either conducts to a distance or radiates into space the electro-magnetic waves (third claim of my English patent No. 1,555, of January 24th, 1900).

Only one method is known—at present at least—of realising very high frequency, millions of periods per second, for instance; this is the spark, which is to a certain extent (see theory in the above-mentioned patent) a very rapid interrupter, giving extra closing and breaking currents.

But to produce the spark, more or less high tensions are required, whereas in cables we must not exceed tensions of 10 and 20 volts, *i.e.*, tensions practically insufficient for the production of sparks. Higher tensions would endanger the safety of the insulation of the cable. Besides the inductive method, therefore, we require at the transmitter the transformation to low tension of the Hertzian waves. (ELECTRICAL REVIEW, January 18th, 1901.)

Moreover, we know that it is advantageous, and we know why it is advantageous, to raise the tension in the circuit of the coherer. In this case it becomes indeed a necessity, since we are obliged to do what is not done in wireless telegraphy, viz., transform the wave into low tension at the transmitter.

The inductive method with transformation at the transmitter and the receiver is claimed in my English patent, No. 1,555, 1900.

The most simple arrangement for realising this kind of telegraphy—an arrangement the results of which I gave in the ELECTRICAL REVIEW for January 11th and 18th, 1901—is shown in fig. 1. A telephone acts as receiver. It will be observed that the transmitter, if we consider the line wire as equivalent to the antenna—as I suggest in the third claim of my patent—greatly resembles the last type of Marconi transmitter (ELECTRICAL REVIEW, June 14th, 1901). In the Marconi transmitter the oscillator is in shunt instead of being in series, and a condenser, introduced into the circuit of the windings of the two transformers, serves to regulate the length of wave. In the experiments I described

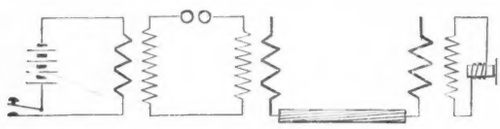


FIG. 1.

(ELECTRICAL REVIEW, January 11th and 18th, 1901), I used condensers connected in shunt on the oscillator. In addition Marconi connects to earth one of the terminals of the secondary of the second transformer, which, I have reason to believe, is not indispensable or even necessary, especially in the kind of telegraphy that is occupying our attention (ordinary). It may be otherwise with wireless telegraphy, but I think not, when unipolar transformers are used, of the Rochefort type, for instance, in which, without any connection to earth, all the tension is conveyed on the side of the radiating wire.

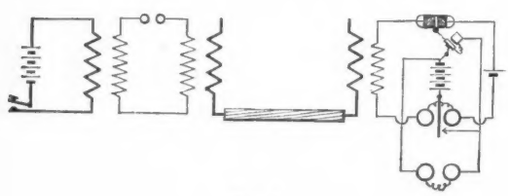


FIG. 2.

Fig. 2 shows the application of the coherer reduced to its most simple expression. These two arrangements are described, illustrated and claimed in my English patent above-mentioned.

To realise multi-communication, we have only to use an arrangement similar to that which Marconi uses for wireless telegraphy. In fig. 3 the cable takes the place of the transmitting antenna, with the Marconi receiver, the transformation at the transmitter being the reverse of that used by Marconi in wireless telegraphy, for reasons explained above. The Slaby method is also applicable (fig. 4). The figure clearly indicates in what manner. The transmitter remains the same as in fig. 3. The receiver is the

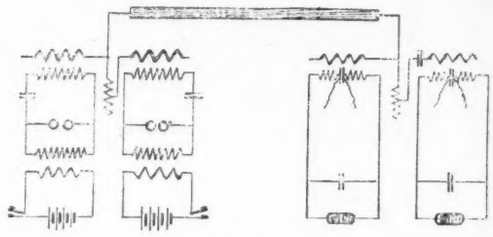


FIG. 3.

Slaby receiver; the secondary of the transformer corresponds to the receiving antenna (the primary of the transformer being the transmitting antenna).

For those who do not already know it, we will mention that the Slaby method of multi-communication in wireless telegraphy consists in placing the coherers between ventral

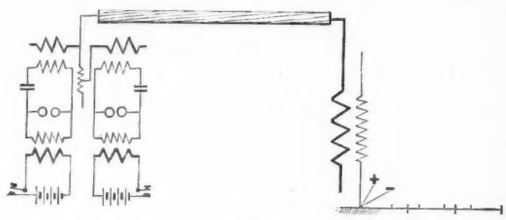


FIG. 4.

segments (of tension) of opposite signs by using wires of suitable lengths. This is, in other words, the method which M. Turpain ("Practical Applications of the Electric Waves") has applied since 1898 for the realisation of multi-communication in ordinary telegraphy. The arrangement shown in fig. 5 is very little different from that shown in fig. 4. It is another way of placing the coherers between ventral segments of different signs. This arrangement serves another purpose also. In a former article we showed how, with a current of low frequency, transmission by short dis-

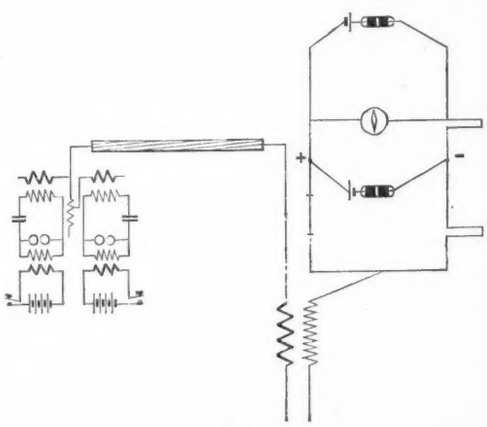


FIG. 5.

tinct signals could be realised by means of two coherers with their batteries suitably arranged. The deviation in either direction of the needle of the galvanometer was obtained by sending into it positive or negative currents. The arrangement shown in fig. 5 acts in the same way for the Hertzian waves; the needle of the galvanometer deviates in one direction or the other according to which coherer is influenced. The length of the wave transmitted will decide

which coherer is influenced. Thus we can with Hertzian waves realise either ordinary or wireless telegraphy with a coherer by short distinct signals by using for each transmitting and receiving apparatus a series of two transmitters and two receivers.

(To be concluded.)

RETAILERS IN THE ELECTRICAL TRADE.

[COMMUNICATED.]

THE grievances of which the retail electrical trade has for a long time complained have recently, as most people know, culminated in the formation of an association of Electrical Contractors. The members of this association have combined chiefly for the purpose of forcing the wholesale houses to confine their business entirely to the retailer, and to prevent them giving discounts to those members of the public who, from the nature of their business or their personal relations with the wholesale houses, may consider they are entitled to such privilege. Should a wholesale house, despite the association, be caught selling a switch to a hotel or a club (perhaps quondam customers of certain retailers), then this house is to be boycotted, and the members of the association will not retail its goods. These are the principles of the association, although it must be admitted that they are not put in quite so nasty a way in the rules; nevertheless, the combination will have more or less power to enforce them, and, if we admit that business cannot be done without the middleman, it would appear on the face of it that the action of the association is justified. It is, of course, possible, although not probable, that a wholesale electrical house could do business direct with the public by obtaining financial control of a considerable number of retail concerns; but, as has appeared recently in the changes effected in the tobacco trade, to do such a thing only causes those retailers not affected to combine with an opposition house, and the position is practically "as you were."

The grievances of which the retailers have complained are chiefly—(1) The selling of goods such as fittings (with or without discount) to those members of the public who come with a shipper's card, or with a personal introduction, or who are personal friends of the management; (2) the selling of goods direct to shops, clubs, hotels, &c. (with or without a discount); (3) the advertising in non-technical journals, by which the public find out who are the makers and buy direct from them. It will be the writer's endeavour to show that their grievances are to a great extent due to the retailers themselves, owing to their general want of enterprise and energy.

There are always two sides to every question, and if the wholesale houses have, rightly or wrongly, encroached on the unwritten rights of the retailers, it is only because the latter have been found wanting in their function of supplying the demands of the public—nay, in creating public demands. The distributing channels having become inefficient, the main has shown leaks in several places, and whilst it may appear necessary that the leaks should be stopped, the channels which caused the accumulation should also be cleared.

The whole question, to begin with, resolves itself into this: If the public will not deal with the retailers, but insist on going to the fountain head, what are the wholesale houses to do? Are they to refuse to serve the public, and to refer them to the retailer, or are they to compete with their own retailer? Before this question can be answered it is necessary to put another one: Why do the public endeavour to dodge the retailer? The reply to this brings us to our subject—because the retailer is not enterprising; because he is dear; because he fails to educate the public as to novelties, or to bring before their notice what they want; because he does not acquaint himself and his assistants with the technicalities of the business; because he is careless in his estimates and his accounts. In fact, the public is sick of the "local shop."

Under these circumstances we again ask: What should the wholesale houses do? They should, whilst the middleman continues to be their chief source of distribution, give him their support in every way, but they should, in return, demand that he gives the business that proper attention which should make it unnecessary for the public to dodge him. Of course, it may be argued, it is impossible to interfere with a man's business and the way he conducts it; but if the retailers, through their combination, can bring pressure on the wholesale houses, in order that the latter should maintain a proper attitude towards the retailers, the wholesale houses as a federated body might equally well bring to the notice of the Contractors' association the name of any man who does not appear to be doing his duty towards the public, and therefore towards his suppliers. It is not a question of whether he pushes A's goods in preference to B's goods; this merely shows that A's traveller is better than B's traveller. It is that he does not push anyone's goods, but is content to wait for the public to look him up; he is, in fact, spoiling the wholesalers' trade in his neighbourhood, and neglecting to keep money in circulation.

In making these charges we are quite aware that there are many retailers whose methods of enterprise have enabled them to come to the fore and to prosper; it is these firms which make the contrast all the more striking when we consider the general local "ironmonger, sanitary engineer and electrician," or the "electrical engineer" pure and simple. "Oh yes," these will tell you, "the reason why the others have got on, or have not been mentioned in the *Gazette*, is because they have more money than we have; they are able to keep a good stock, employ a large number of men, and can advertise. They can afford to be enterprising; we cannot."

All this is, of course, mere stuff and nonsense. It is by their businesslike methods in the first instance, by their efforts to attract the public, and to make the public support them, that these firms have prospered.

What does the average man, such as we have described, do to promote trade? We know of hundreds all over the country who are content to write the sign "Electrical Engineer" over their shops, leave a few incandescent lamps lying about in their windows, hang one or two out-of-date fittings up with their gas fittings, distribute a few bells, telephones and pushes about the shelves—and then continue to lazily dispense tin-tacks and water-cans across the counter, and complain that the electrical business does not pay. In the meantime, the above-mentioned electrical stock becomes rusty, and the public is less than ever attracted by it. Accompanied by this *laissez-faire* attitude as regards his own business, the retailer assumes a dog-in-the-manger attitude towards the wholesale houses. The latter, having found by experience that trade is vegetating in his neighbourhood, will perhaps get their travellers to call on a few institutions or hotels, or will circularise these in the spring with electric fan pamphlets, or, in the autumn, with incandescent lamp circulars. Then it is that the retailer shows energy, but in the wrong direction. Instead of following up these circulars, acting as his own traveller, and informing possible customers that he can supply fans, or lamps, or whatever may be in season, he becomes abusive towards the wholesale houses, alleging that these are cutting him out, and endeavouring to "get at" his own customers. It does not occur to him that he has had just as much opportunity to secure the custom himself, but that he waits for this just as he waits to be asked to mend a cistern, locate an escape of gas, or repair a crank bell.

He does not understand that it is necessary for him to get straight to the public, to force himself, as it were, under their noses. Occasionally he prints poor-looking circulars of oil stoves or garden hose, and these are sent round in open envelopes under ½d. stamp, or distributed by hand. But the majority of the public consign an open envelope to the waste paper basket without examining its contents, and in many houses the servants are instructed not to deliver advertisements upstairs. As for circulars slipped under the door, or into the letter box, these are destroyed at once when received, and in many cases the messenger cannot be relied on to deliver them at all.

What then, it may be said, would you have the poor man do? You cannot expect him to purchase an expensive stock, print extravagant circulars, and send these round his

district by 1d. stamp. The answer is simple. If the retailer can show the wholesale houses that he is enterprising—that he is willing to take certain risks if backed up by them, and that he has some smart ideas—it is certain that they will support him, for his success is their success. It is not difficult for him to get a certain amount of showroom stock on very easy terms on consignment account; the business, often brought by a good display, is surprising. He can usually get as many showcards, showboards, &c., as he requires, if he will only demonstrate that he means business. And is it not a fact that the wholesale houses will often feed him with well-printed circulars printed with his name and address for nothing? He may have a smart idea for advertising or circularising certain goods in his district, and if he approaches the makers, it is more than likely that they will do the printing for him, and sometimes the postage too. But what he so often does is to leave the circulars which are given him lying about on his counter, where they get picked up by curious children or trodden under foot; those people whose custom he requires do not take them. Or, if he does not sell them for waste paper, they are sent round as above described, which means so much money lost to him and to the wholesale houses. How often is it that he takes the trouble to thoroughly acquaint himself with the new branch he has taken up, or to employ a competent set of men to do his bell, telephone or electric wiring work. Failing his understanding the subject, small wonder that he does not make a house-to-house canvass, either personally or by letter, and that he makes no earnest attempt to attract customers to his shop by any display of novelties.

It is only necessary, in one's own circle of acquaintances, to consider the number of instances where business might be done with the several applications to which electricity lends itself in the daily routine of life, were only some of the local so-called "electrical engineers" to push their business properly, and to bear in mind at the same time that all this field is lost to the wholesale houses many thousands of times over. Will anyone acquainted with the electrical wholesale and retail trade venture to deny that what has here been set forth against the retail trader *as a whole* is not true in more or less every locality in the United Kingdom? Under the circumstances, there should be no wonder that the wholesale houses have endeavoured to trade direct with the larger kind of customer, such as clubs, hotels, and other institutions, and have tried by other means, such as advertising in non-trade papers, to stimulate a demand amongst the public for their commodities; and by all laws of right, it is very unreasonable on the part of the retailer to object because some hotel, for instance, on his books has received a circular from a wholesale house. He should have seen that the hotel was kept up to date with such information by himself.

Again, it is a common cause of complaint that the retailer is dear; in many cases this is well founded. He may be enterprising, smart, and well acquainted with the technicalities of the business, but if he is not satisfied with a reasonable profit, by which he is likely to more rapidly extend his turnover, he does as much to stifle the business as if he were incompetent only.

In the matter of accounts and estimates the small "electrical engineer" is proverbially bad, and it is not surprising that the man who is only half-illiterate does not prosper in the electrical business, although he may be able to correctly estimate and charge for (!) a plumbing job.

We think it has been amply demonstrated why the public endeavour to do away with the middleman; that they also try to get discounts shows that they are imbued with what he lacks,—namely, business instincts. And whilst it is only proper that the wholesale houses should continue to support the retailers by refusing such discounts and by referring the public to reliable contractors, it is also quite fair for them to expect that the retailers will show such increased enterprise (with or without the manufacturers' support) as will render it unnecessary for the latter to sell direct to anyone but the retailer.

Cleckheaton.—The D.C. has resolved to apply to the L.G.B. for sanction to borrow the further sum of about £6,000 for electricity purposes.

THE GOVERNMENT AND ELECTRICAL LEGISLATION.

It will be remembered that one of the recommendations made by the committee appointed by the Council of the Institution of Electrical Engineers, to inquire into the effect of legislation upon the progress of electrical engineering in this country, was to the effect that a deputation should wait upon Lord Salisbury. The purpose of the deputation was to impress upon his Lordship the detrimental effect of present legislative enactments and to urge immediate remedial action.

Unfortunately, the Prime Minister did not see his way to receive the deputation personally, but referred the matter to the President of the Board of Trade. The pressure of public business has caused the meeting to be twice postponed, but on Wednesday morning, the 18th inst., it was found possible for the desired conference to take place.

The deputation was of a thoroughly representative character, consisting, amongst others, of Lord Kelvin, the Earl of Rosse, Lord Greenock, Sir Michael Foster, M.P., Sir Thomas Wrighton, M.P., Mr. James Swinburne (President of the Institution), Dr. R. Spence Watson, Major-General Webber, C.B., Lieut.-Colonel Crompton, C.B., Prof. Perry, Prof. S. P. Thompson, and Messrs. Stephen Sellon, Morse, R. P. Sellon, Madgen, Patchell, Ferranti, Sparkes, Mordey, and Mr. MacMillan (secretary of the Institution).

The deputation having been introduced to the President of the Board of Trade (Right Hon. Gerald Balfour, M.P.) by Lord Kelvin, Mr. Swinburne proceeded to explain why they had sought the interview. He referred to the report of the Committee appointed by the Council of the Institution to consider the subject, and reminded Mr. Balfour that, on the advice of Lord Salisbury, they came to him, not merely as President of the Board of Trade, but also as a member of his Majesty's Government, and they asked that their wishes should be communicated to the Cabinet. When electrical distribution for lighting purposes became practical about 20 years ago, the fact that it was necessary to obtain permission to open up streets for the purpose of laying cables at once brought the industry into contact with local authorities. Were it not for this, the speaker said, the electrical industry would be as free of special control by local authorities as other trades. The special care taken by Parliament at that time to conserve the interests of local authorities resulted in the passing of an Act which discouraged the industry and prevented progress, until some of its most stringent conditions were modified six years later. These Acts were based on the assumption that an electricity supply undertaking would carry on all its operations within the area of a single local authority. Now that a single scheme may deal with the supply of an area of a thousand square miles and upwards, and deals not with a single parish but with several counties, the purchase clauses by which local bodies can at the expiration of a given period purchase the undertaking are out of date, and in many cases wholly inapplicable. Electrical enterprises should have their limits and boundaries set by economical considerations alone, and arbitrary boundaries, mostly of mediæval ecclesiastical origin, should not limit the distribution or the growth of electrical systems. Mr. Swinburne went on to say that they did not come as opponents of municipal enterprise. Their desire was to have the powers of abuse of their present legal powers by local authorities checked and rendered impossible by new legislation. They could prove that in many cases the action of local authorities had been not only prejudicial to the industry but harmful to the best interests of the ratepayers, for it was of national importance that as cheap as possible a supply of electric energy should be available to all. In addition to the power of compulsory purchase of both lighting and traction systems, the power of veto at present vested in local authorities needed considerable modification. Several points in which the Board of Trade were themselves particularly interested were then mentioned, such as the reorganisation and increase of its electrical staff, and the necessity of more frequent modification of its existing regulations, and the help of the Institution was offered in discussing and framing new regulations if such assistance were desired. Mr. Swinburne concluded

by again drawing attention to the wider issues concerned in the necessity for new legislation, and urged the need for the appointment of a Royal Commission to inquire into the merits of the whole question.

Lieut.-Colonel Crompton pressed home the contention of Mr. Swinburne by instancing the case of Hove, where the powers originally obtained by the Commissioners were taken over by a company. During the first few years of its existence the company was left unmolested, but since the time it commenced to make a profit, every effort had been made by the local authority to thwart its progress and impede its work. For instance, when a new site for a generating station had been secured they refused to allow the mains to be laid for a short distance to bring the current within the company's area, and when a proposal was made to raise the voltage from 110 to 220 volts, they actively canvassed consumers to urge them to refuse consent to the change. Then, referring to the practice in Germany and Switzerland, where, if anything, more care was taken than in this country to protect the life of the citizen, but where greater facilities were given for the carrying out of complete schemes, he recommended the formation of a committee of experts, who should assist the present technical staff of the Board of Trade in dealing with new proposals brought before them.

Dr. R. Spence Watson, as a director of some of the electrical undertakings in the Tyne district, spoke of the serious effects of the capricious use of the power of veto by small local authorities. He pointed out how every extra burden laid on a commercial undertaking resulted in a higher charge being necessary for its products, since to exist it must make a profit, and, in the case of an undertaking liable to compulsory purchase, provide an amortisation fund. The possibilities of electrical engineering were very high, and it was a question of national importance that its progress were not checked by restrictive laws. The possession of the power to veto proposed electrical tramways made local authorities very unreasonable, and in certain cases they imposed most unjust conditions as the price of their consent. The speaker referred to a case which had come under his immediate notice, in which two authorities had power over the same roads, and one insisted upon the line being laid in the centre of the road, while the other was equally insistent upon it being placed at the side.

Mr. Sydney Morse dwelt upon the serious effect which this power of veto entailed, not merely upon the industry, but upon the public. He quoted extracts from speeches made by Lord Morley in the House of Lords, on July 11th, 1901, and Mr. John Burns in the House of Commons, on May 15th, in the present year, proving the injustice of the present condition of affairs, and urging reform. Wolverhampton was mentioned as an instance where a promising scheme affecting a wide area was crippled because the promoters would not consent to purchase electric energy for that portion of the system within the Wolverhampton municipal area at a price they considered prohibitive. Belfast was another case in point. At Swansea the introduction of electric traction rendered an increase in the number of passing places advisable in the interests of the public, but the Corporation withheld their consent until a payment of £5,000 was made to them. He was aware that no absolute power of veto to local authorities was given under the Light Railways Act, but the standing orders of Parliament, and the following of precedent by the Board of Trade resulted in practically the same thing. He believed that the new Bill on this matter, prepared by the Board of Trade, would to a certain extent remedy matters, and he urged in the interests of the country, which demanded the best service at the lowest price, its early presentation to the House of Commons.

Sir Michael Foster, speaking as one of the secretaries of the Royal Society, acknowledged the many obstacles which, in this old country, were placed in the path of technical progress, and said he was sure that all scientific men would welcome a change in the attitude of the Legislature towards electrical engineering projects.

Mr. Ferranti emphasised the importance of cheap power supply, and spoke of the difficulties which the promoters of the Midland power scheme had met with. The insistence upon underground mains, even for pioneering work, had proved costly, and was contrary to the practice on the Continent; while the regulations regarding permissible variations of voltage, limits of sizes of feeders and transformers, also needed revision. In order to keep abreast of the times and the progress continually being made, the regulations needed constant revision, and he feared that a large increase in the electrical staff at the Board of Trade was a real necessity. The tendency of legislation in electrical matters had been most repressive; that relating to traction needed immediate revision, and he hoped that the Board of Trade would take the side of progress against the vested interests, whose influence had been so detrimental to the public interest.

Dealing with the points relating to his own Department, Mr. Balfour promised with reference to overhead wires to consider any case brought before him on its merits, and as regards the others to carefully consider any proposals as to their amendment submitted by the Institution. He was not convinced as to the necessity for increasing the technical staff at his disposal, and asked for any further evidence of its insufficiency.

Mr. Patchell, while acknowledging the courtesy he had always experienced at the hands of the permanent officials, pointed out the uncertainty of the application of many of the regulations relating, for instance, to extra high pressure, and the thickness of dielectrics, and remarked upon the insistence on earthing the centre point of a three-phase system as not in accordance with latest ideas.

Mr. Balfour then proceeded with his general reply. He recognised the importance of the subject, and to a large extent sympathised with the deputation. It was undeniable that more rapid progress had been made in electrical engineering in other countries. While the legislation dealing with the question was no doubt susceptible of considerable improvement, and it was possible that some local authorities had abused the powers given them by Parliament, he did not think that this fully accounted for the present position. He thought that to a large extent the rapid progress in the United States was due to its being a new country, sparsely populated and having comparatively few established interests to be contended with, whereas in this country the reverse was the case. It was in his opinion these fundamental conditions rather than any legal enactments which retarded the progress of electrical engineering in this country. It seemed to him that the really important question was not so much any impediment thrown directly by Parliament in the way of the development of the electrical industry, as the power reposed by Parliament in local authorities to veto schemes with which they were not in agreement. With respect to this, there were two branches of the subject, viz., the supply of electric energy for lighting and power purposes, and electric traction. In the case of tramways, so far as these matters were still determined by the Act of 1870, the local authority had an absolute veto as regarded provisional orders, and by a standing order, the House of Commons also possessed an absolute veto upon measures proposed to be promoted by means of Bills. To some extent the evils flowing from that condition of things had been remedied by the adoption of the Light Railways Act, even when the scheme was, in the proper sense of the word, a railway on a road, or a tramway; but it was true that both the Light Railway Commissioners and the Board of Trade had considered themselves more or less bound by the regulations laid down in the Tramways Act, and the Standing Orders of the House of Commons. While he did not think they had gone the length of giving the local authority an absolute veto, no doubt they were influenced by these provisions. The question had recently been investigated by a Departmental Committee, upon which both promoters and local authorities were represented, and what he hoped was a reasonable compromise had been embodied in a Bill which he intended to introduce into the House of Commons on an early occasion. They must, however, remember that local authorities represented a great power, and they were fully alive to the fact that it was to their interest to possess, if not an absolute veto, at any rate such a position that they could make their views felt. A few weeks ago an attempt to alter this Standing Order of the House of Commons had been abandoned, on account of the opposition it aroused. This illustrated the difficulties to be met with in any attempt to deal with the

situation. The Committee of the House of Commons which reported in 1898 had made a series of recommendations in regard to modifications of the present Acts relating to electric supply; but before the Board of Trade could act upon them, legislation regarding them was necessary. Fortunately, when powers for electric supply undertakings over large areas were sought for by Bill, these recommendations formed a precedent and were acted upon, otherwise they were inoperative. The Board of Trade had drafted a Bill to give effect to them in ordinary cases, but he had not yet been able to bring it forward. In the present state of public business he could hold out but little hope of either Bill being passed this session, but they would be pressed at the earliest possible moment. Meantime he would assure the deputation that the Board were not insensible to the needs of the electrical industry, but were as anxious as themselves to secure that the public interests should be properly served by its due development.

In thanking Mr. Balfour, Mr. Swinburne pressed for an answer to their request for a Royal Commission to be appointed to inquire into the whole matter.

Mr. Balfour stated that this was a matter for the Cabinet, and that he would bring the matter under their notice, but he could not pledge himself to give his support to the application.

There was a general feeling of regret that the Prime Minister had not been able to meet the deputation, since there was a danger, apparent from time to time during the interview, that any discussion of the matter with the President of the Department most interested in the question would resolve itself into disputes about details, and leave the questions of principles untouched. It was largely owing to Mr. Swinburne's tact that such was not the case. The case presented by the deputation was a strong one, and its failure to arouse the Government, as represented by the President of the Board of Trade, to a more active concern for the removal of disabilities which are injuring the prosperity of the country, is only one more reason for an active campaign on its behalf.

CORRESPONDENCE.

A Scandal which Everybody Admits.

My attention has been called to the paragraph on page 990 of your issue of June 13th, in which you make a statement which certainly requires an answer from me.

You refer to my evidence before the committee of the Institution of Electrical Engineers, in which I stated that men who left us as pupils, and who were failures in everything, have blossomed out into consulting electrical engineers. You wish to know if these failures in everything were retained in the Arc Works during the full term of their pupilage.

Now, sir, no one knows better than you do that we have been taking pupils for upwards of 20 years, and during that time a very large number of gentlemen have received their education as electrical engineers at our works. Of these an unusually large proportion have turned out to be successful engineers, and are now amongst the leading members of the profession, but in the nature of things, a small minority of them have been less successful when tried by the severe tests as engineers in charge of contract work or as manufacturers on their own account.

It is unfair for you, or anyone else, to lay the blame of unsatisfactory training on the shoulders of the firms who take pupils. The fault does not lie with them. They can only make the best of the material supplied to them, and it is evident that out of this material, among many successes, there will be a few failures. That these failures should gravitate into the ranks of consulting electrical engineers is, I believe, generally due to the want of care of the local authorities in ascertaining for themselves the antecedents of the consulting engineers they employ.

It is one of the disadvantages of having to speak the truth on such a highly disagreeable matter that you force me to make this public explanation, but knowing as you do the extreme importance of the work the Institution has been doing in collecting this evidence and in attempting to probe to the bottom the causes why our country is behind hand in electrical engineering progress, you ought to have, at least, communicated with me for a further explanation of my evidence before remarking on it in a manner which is calculated to hurt the feelings of our past and present pupils and of their friends.

R. E. Crompton.
F. R. S.

[We are glad to publish this disclaimer, but why did not our correspondent state in his evidence what he tells us now? He made no mention of his successful pupils, but only of those who were failures in everything. It is Lieut.-Col. Crompton himself who is unfair in suggesting that we attributed blame to the firms who take pupils; we merely asked a question, and attached no blame to anybody.

Our correspondent's reasoning as to the manner in which these failures become consulting engineers savours of the Emerald Isle. The failure has already gravitated before the local authority has anything to do with him.

Touching the concluding portion of our correspondent's letter, we would like to ask of what use is published evidence if further explanation is necessary before drawing attention to any part of it? The lot of an editor is not altogether a happy one at the best of times, and life would not be worth living if we had to appeal to everybody who elects to give evidence upon any given topic to ascertain whether his testimony required further explanation. Imagine the editor of a London morning paper corresponding with Mr. Chamberlain as to whether his speech at a political meeting the previous night formed really what he wished to convey to his hearers, or something entirely different.

Lieut.-Colonel Crompton made a deliberate and sweeping statement which was duly reported in our columns; if the matter is disagreeable to him, and calculated to hurt the feelings of his past and present pupils, the blame is his, not ours, for we, as well as the gallant officer, have a duty to perform towards the electrical engineering industries and the local authorities.—Eds. Elec. Rev.]

Referring to a note under the above heading appearing in your issue of June 13th, and to Mr. Morgan Williams's letter of June 16th, I should like to make a few remarks on this subject.

In the first place, I think that you yourselves will admit that the sum and substance of the remarks quoted by Colonel Crompton are perfectly true, and that one of the causes of the backwardness of the electrical industry in this country can be traced to the state of affairs existing in the past, of allowing consulting engineers, as a body, to dictate to the manufacturers.

It certainly does seem rather absurd that the late pupils and members of staff of firms, who have been unable to justify their existence in this branch of the business, when incompetence cannot be tolerated for long, should be able to turn round and act as dictators to the manufacturing firms.

No doubt Colonel Crompton would have somewhat modified his remarks if they had been delivered in a public speech, where one is often debarred from giving a plain, straightforward statement of the case; but it does seem a mistake if, before a Committee of the Institution of Electrical Engineers, appointed specially to inquire into the causes of the backwardness of our industry, plain speaking is to be prevented.

I think that if the Institution wishes to obtain the help and the opinion of manufacturers, whose mouths are naturally closed in public to a good many existing evils, that the proceedings should be considered privileged, and that statements made by them should not be published if likely to prejudice their individual interests.

I suppose there are more old "Crompton" pupils in good positions in the electrical industry than any other single firm can point to, but it stands to reason that the number of those that have not succeeded is a still larger one.

This state of affairs applies to all firms taking pupils, and is, I think, only to be expected.

The grievance would seem to be that this large body of so-called failures among both staff and pupils of the different manufacturing firms drift into consulting work—a class of work which really requires the very highest instead of the very lowest qualifications—and that, in this position, they are able, for the time being, to exist, to be of considerable hindrance to the manufacturing industry at large, and, it is to be feared, in many cases to their clients as well.

I have the greatest respect for the better qualified consulting engineers, but hope to live to see the day when their profession will be closed to the riff-raff of the industry.

X. Y. Z.

Meters.

We have noticed the correspondence in your "Legal Query Column," wherein reference is made to the Long-Schattner prepayment meter.

As the question of consumers "running" on the dimming resistance has occurred once or twice, it will, perhaps, not be out of place to supplement your answer with some further information.

It seems to us that "Inquisitive" has not seen the exact type of meter "approved by the Board of Trade," as the dimming device in that type consists of an 8, 16 or 32-c.p. lamp contained in the instrument. Now, in the event of a consumer choosing to "run" on this dimming resistance, his lamps will only give him about 20 per cent. of their proper amount of light; furthermore, he will not be able to get his full pressure on again until he inserts sufficient coins to pay for all the current he has used on the "dull" system. We find that this gets over the whole difficulty, but if this course is considered desirable, the collector can extract the "dimming lamp" from the meter, and the consumer will then be in darkness until he inserts sufficient coins to bring the lever over.

The Schattner Electricity Meter Company.

E. B. Schattner, *Engineer and Manager.*

June 20th, 1902.

PARLIAMENTARY.

London United Tramways Bill.

The Select Committee of the House of Commons, presided over by Mr. Compton Ricketts on Tuesday last week, heard evidence from frontagers in opposition to the Wimbledon portion of the Bill.

On the following day, Wednesday, the Rev. C. P. Clarke, of Holy Trinity Church, Merton Road, said he withdrew his opposition to the Bill, as terms had been agreed upon between himself and the promoters.

Mr. Ravenshore, auctioneer and surveyor, of Ealing, pointed out that since the electric tramway service had been introduced, there had been a decline in the rents of the larger houses.

The Rev. B. M. Kitson, rector of Barnes, said it was the opinion of the majority of the inhabitants of Barnes that the proposed tramway from Hammersmith to Richmond was unnecessary, as the present omnibus service met all requirements. In this district there was a working class population of about 2,000, a considerable number of whom were employed by the London and South-Western Railway.

Sir C. Elliott, chairman of the Finance Committee of the London School Board and chairman of the Wimbledon Elementary Schools Committee, said he feared the proposed tramway would increase the danger to the young children attending the schools. He would suggest that a clause be inserted prohibiting compulsory acquisition of any of the school property, and requiring the Company to make such alterations in entrances as the Board of Education should think would be adequate to prevent risk of danger to children.

The Chairman intimated that it was thought a clause regulating the speed of the cars past the school to walking pace would be sufficient.

Mr. Burroughs, architect, said he could not express an opinion as to the effect of the embankment and heavy traffic upon houses in Barnes Terrace, but the possible effect of alterations of drainage upon the foundations of an old house built on a clay soil would be considered.

On Thursday Mr. Cross, of Barnes Terrace, contended that the tramway to be laid in his district would be of no advantage to the inhabitants, and that the proposed embankment would be a source of danger and inconvenience to rowing men.

Lord R. Cecil, K.C., who addressed the Committee on behalf of the frontagers, said he took special objection to the Richmond and Hammersmith line. The embankment at Barnes, he thought, was not such an improvement that it would justify the construction of a tramway. At the present time a tramway service was being run between Richmond and Hammersmith, and although there was a break at Kew Bridge, there would be another break in the projected southern connection at Hammersmith Bridge. He maintained that the needs of Barnes and Mortlake were met by train and omnibus services.

Mr. C. J. Owens, the general manager of the London and South-Western Railway, gave evidence in opposition to the Bill. He said that between the stations at Kew Bridge, Brentford, Isleworth and Hounslow, there had been a reduction in the gross receipts from £1,516 to £524 in the half-year since the completion of the tramways. The present proposals, if sanctioned, he feared would have an equally injurious effect on the traffic of the company. It had not been found that the action of tramways as feeders to railway stations had any compensating advantage. The promoters had put forward as an argument in favour of the Bill that extensions into the outskirts would help to relieve the congestion of the population of London, but he had noticed that a witness who had supported that argument in a speech at Richmond, had urged the Corporation to buy land for the working class accommodation to prevent its being acquired for London generally. An agreement for the electrification of the London and South-Western line between Richmond and Hammersmith and other parts of the line was about to be concluded between his company's directors and the Metropolitan and District Railways. The proposed tramway from Wimbledon to Malden would mean a duplication of the route traversed by the railway. Last year there were 838,819 passengers carried on the railway from Wimbledon and Raynes Park to stations on the route of competition, and the receipts from that source were £9,479, with an average of 2¾d. per passenger. It was stated that a reduction of the traffic in proportion to the past experience of tramway competition would mean a loss of £6,000 to the company. The London and South-Western Railway Company were spending £1,700,000 on improvements between Clapham Junction and Waterloo, in view of the competition of the Tooting extension. A railway company had to go to great expense to purchase their land in order to construct their line, but a tramway company had the free use of the road, with public lighting paid for out of the rates. He maintained that the needs of accommodation for the working classes of Richmond did not justify the competition by the proposed tramway. A passenger on his company's line was able to travel 19½ miles for a 6d. return ticket. In 1901 the railway company had issued 103,364 tickets by six workmen's trains. There was a very small demand for workmen's tickets on the line between Richmond and Hammersmith, the average being about seven in a train on the District Railway. The Committee adjourned.

On Friday last week the evidence for the London and South-Western Railway in opposition to the Bill was completed.

Mr. Pember, K.C., in addressing the Committee on behalf of the railway company, said that the loss to the London and South-Western Railway Company since the development of electrical tramways in London and the suburbs amounted to £10,000 a year. The tramway companies should proceed with the work before them in the construction of their authorised lines before asking for further powers. The piling up of unexecuted schemes was the result of competition between promoters who wished to keep out rivals. As a result, great monopolies were being created, and the map was being covered with a large number of authorised but not constructed lines. He maintained that the evidence for the promoters had not shown that there was any necessity for the extensions, as the existing railway company was capable of supplying the demand. The electrification of the London and South-Western Railway Company to Richmond and Wimbledon would give quicker and more frequent trains. If railway companies were to be subject to tramway competition, it would tend to discourage improvements being made on suburban lines. He did not mean to imply that the railway companies had a vested interest and should be protected against all competition, but he did submit that only a case of very urgent public necessity would warrant the Committee in passing the Bill before them, and such necessity had not been proved.

Mr. Fitzgerald, K.C., replying for the promoters, said that if the argument of Mr. Pember was to prevail there would be an end to tramway extension in London, for nearly every tramway was more or less a competitor with a railway. The tramways, however, to a great extent created their own traffic, and in the case of the London United Company, the Hounslow traffic had never been carried by the South-Western Railway. The result of the construction of the tramways as proposed, together with the tube railway, would enable a workman to go from Richmond to London for 4d.

After considering in private, the Committee approved the whole of the northern group of lines on the Hammersmith and Shepherd's Bush system. They also approved No. 7 and No. 6 line of the Kew portion of the scheme (Richmond, Mortlake and Barnes) to the south side of Hammersmith Bridge. The Wimbledon group was also sanctioned, except a small piece of line to have run alongside the common. The time during which the Barnes Council was to be enabled to exercise its option of purchase they reduced from 50 to 30 years.

The clauses were then considered and amended.

CAVEHILL AND WHITEWELL TRAMWAYS.

LORD NEWTON presided last week over a Select Committee of the House of Lords to consider the Bill of the Cavehill & Whitewell Tramways Company. Mr. Balfour Browne, K.C., opened the case for the promoters.

Mr. Kirkpatrick, J.P., of Ballyclare, gave evidence in support of the Bill, which, he said, if passed, would confer a great service on the district.

Evidence was given on behalf of the Bill by Mr. Sellon, the engineer to the British Electric Traction Company. In cross-examination, witness said that the company had made several attempts to do business in Ireland, but hitherto without success. Up to the present Ireland had not been a fruitful soil for tramway enterprise. His company never purchased an interest in a tramway in order to sell it again, but they always retained the control themselves. Mr. Fitzgerald addressed the Committee on behalf of the Corporation.

Local evidence having been tendered in opposition to the scheme, the Committee found the preamble proved. On the consideration of clauses, Mr. Fitzgerald, on behalf of the Corporation, asked for a clause providing that the drivers and conductors should be licensed by them. The Committee agreed to insert the clause. Mr. Fitzgerald next asked that Clause 10 of the Bill providing for the protection of telegraph lines from interference by the electric lines of the company, should be extended to the Corporation, who were licensees of the Postmaster-General for the telephone service. Mr. Sellon said that if such a clause were given, it would enable the Corporation to erect and use the most inferior sort of wires for their telephone system, and would cripple electric traction in Belfast for years to come. The clause was rejected. Mr. Fitzgerald finally asked for the insertion of words in one of the clauses requiring the company to obtain the consent of the Corporation to make, maintain, alter, or remove crossings, sidings and junctions. Mr. Balfour Browne, K.C., said that such a clause was unnecessary, seeing that the company were obliged to get the consent of the Board of Trade. However, he was willing to agree to it if words were inserted stating that the Corporation's consent was not to be withheld unreasonably. The Committee passed the clause as amended at the suggestion of Mr. Balfour Browne. The Bill will now be reported for third reading.

Dumbarton Electric Lighting.—A Select Committee of the House of Lords, presided over by Lord Newton, sat last week to consider the Electric Lighting Provisional Order No. 5: the only order that was opposed being that of the Corporation of Dumbarton. Mr. Blennerhassett, K.C., opened the case for the Corporation, and said the Bill contained nothing peculiar, for it practically incorporated the provisions of the Electric Light Clauses Act of 1899. The Bill proposed to enable the Corporation to supply electric light in Dumbarton. The practice of Parliament had been to give a preference to local authorities as against private companies, unless there were very exceptional circumstances, which he submitted was not the case here. A great number of provisional orders had already been granted in Scotland to local authorities, far less favourably situated for the supply of electric light than Dumbarton, including Nairn, Galashiels, Clydebank, Alloa, Crieff and Stirling. The population and rateable value of the burgh were steadily increasing. In 1875 the Corporation acquired the gas undertaking, which had been highly successful, and they had good reason for believing that they would be quite as successful with the electric light. There was an excellent site for a generating station. It was proposed to commence with a small installation, estimated to cost £21,000, and to gradually increase the supply as the demand increased. The only petitioners against the Bill were the North British Railway Company, the Lanarkshire and Dumbartonshire Railway Company, and the Dumbarton and Balloch Joint Line Company, who said that, as ratepayers, they were afraid that the scheme might result in a financial loss, which would have to be borne by the rates. The petitioners alleged that there would not be sufficient demand in the burgh for electric lighting, but he asked their Lordships to say that the Town Council were better judges in that respect than the directors of railway companies. An assertion was also made by the petitioners that the order was promoted for the purpose of covering wasteful expenditure incurred by the Corporation in opposing the Bill of the Clyde Valley Electric Power Company last year. Such an assertion was, he submitted, absolutely without foundation, and could not be sustained for a moment. After hearing counsel against the order, the Committee declared the preamble proved.

Cleethorpes Improvement Bill.—All opposition to this Bill has been withdrawn.

Metropolitan District Railway Bill.—The Marylebone Borough Council have withdrawn their opposition to this Bill.

City and Brixton Railway Bill.—The London County Council has deposited a petition in the Private Bill Office of the House of Lords, praying to be heard against this Bill.

London, Tilbury and Southend Railway Bill.—This Bill came before the Standing Orders Committee of the House of Lords last week, and it was decided to dispense with the Standing Orders and allow the Bill to proceed.

Whitechapel & Bow Railway.—Last week the House of Lords Standing Orders Committee considered the Whitechapel & Bow Railway Bill, and decided that Standing Orders ought to be dispensed with and the Bill allowed to proceed.

Electric Lighting Provisional Order Bill, No. 5.—The Select Committee of the House of Lords, appointed to consider this Bill, has reported that opposition is withdrawn. The Bill confirms orders to Ardsley, Barton Regis, Blayton, Chester-le-Street, Church Stretton, Lees, Lower Babington, Newburn, Stanley and Peghill, Easedon and Tynemouth.

Newcastle-on-Tyne Corporation Tramways.—On Wednesday this Bill, which has already passed the House of Lords, came before the Chairman of Ways and Means in the House of Commons, and there being no opposition, the Bill was ordered to be reported for third reading.

Northumberland Electric Tramways Bill.—This Bill came before the Chairman of Ways and Means in the House of Commons last week as an unopposed measure, and was ordered to be reported to the House.

Tyneside Tramways Bill.—On Wednesday last week the Court of Referees of the House of Commons sat to hear a somewhat unusual application—viz., that of the North-Eastern Railway Company for their claim to be heard in Committee against the Tyneside Tramways and Tramroads Bill. Mr. MOON, K.C., represented the railway company, and said that when the matter first came up he argued for a *locus standi* on the ground of competition, but he did not greatly insist on the point of interference with the railway, because he took it for granted that the *locus* on that ground could not be seriously challenged. However, the Court then decided against the railway having any *locus* at all. Mr. Lewis Coward, K.C., objected on behalf of the tramways company to the application being heard, and said he could find no instance of the Court having even granted a rehearing. The Official Referee said there had been two such cases. The Court said it would be a dangerous precedent to allow the case to be re-opened simply because arguments had not been sufficiently pressed, and they decided not to re-hear the case. Later in the day the Bill came before the Chairman of Ways and Means in the House of Commons as an unopposed measure, and there being no opposition the Bill was ordered to be reported to the House. Under the Bill the company is authorised to construct new tramways and raise £60,000 of new capital.

South Shields Electric Railway.—This Bill was before the Chairman of Ways and Means in the House of Commons last week. There being no opposition, the Bill was ordered to be reported for third reading.

Rhondda Urban District Council Tramways.—The Glamorganshire County Council have deposited a Bill in the Private Bill Office of the House of Commons, praying to be heard in opposition to this Bill.

APPARATUS FOR PARALLELLING ALTERNATORS.

ALTHOUGH considerable attention has during the past few years been given to the study of the question of parallel running, as far as the design of alternators is concerned, yet a question of equal importance from the central station engineer's point of view, namely, that of the synchronising apparatus to be employed, has been almost entirely neglected.

In the early days of alternating current, when the generators were small, and the time occupied in parallelling was of less importance than at present, the synchronising lamp answered all requirements.

It was soon realised, however, that to ensure success, a considerable amount of skill was necessary, and as an improvement, the deadbeat voltmeter, usually of the Cardew type, was introduced. Although considered a great advance on the lamp, the voltmeter labours under several disadvantages. In the first place, no matter how deadbeat it may be, there is always bound to be a slight "hunting," and further, there is some uncertainty as to the precise point to which the needle will swing, owing to changes of voltage.

With the ever-increasing size of engine rooms, it often became impossible for the engine driver to see the synchronising lamp or voltmeter, and various kinds of signal were improvised by those in charge of the stations.

Here the subject was allowed to rest until comparatively recently, when Messrs. Siemens & Halske introduced an indicator for use with three-phase systems, in which three synchronising lamps, arranged in a circle, were connected one in each phase, and consequently glowed successively one after the other, thus causing the illumination to apparently travel round. The direction of rotation depended upon whether the in-coming generator was running at a higher or a lower frequency than that of the bus bars. Coincidence of phase was shown by the light ceasing to revolve. A somewhat more complicated arrangement, consisting of a crown of lamps, and giving much the same effect, was also introduced by Messrs. Schuckert.

Both these devices, it will be seen, merely served as frequency indicators, and had, as a rule, to be supplemented by a synchronising voltmeter. Further, they were expensive to instal, owing to the number of transformers required with high-pressure systems.

With the advent of larger generators, it became more and more important to be able to judge with absolute certainty the exact moment for switching in, and further, the time required to bring the machine up to the correct frequency had to be reduced to a minimum, in view of possible emergencies.

The problem has lately been attacked independently both by the Niagara Falls Power Company, of U.S.A., for whom Mr. Lincoln devised an ingenious instrument, and in this country by Messrs. Everett, Edgcumbe & Co., whose apparatus is illustrated in fig. 1.

The obstacles to be overcome were many, but at length a successful instrument has been produced. A hand revolving over a dial shows:—

1. Whether the in-coming machine is running too fast or too slow;

2. By how much it is out of step;
3. The precise moment for switching in.

The instrument is based upon the fact that if the rotor and stator of a rotary field asynchronous motor be supplied from two sources of alternating current of nearly the same frequency, and be so connected that both fields rotate in the same direction, the rotor will revolve at such a speed as will enable the fields to rotate "in step."

In the actual instrument, the rotor and stator are each provided with a two-phase winding. In the case of a two-phase system, suppose the rotor to be connected to the terminals of the generator to be parallelled, and the stator to the bus bars. Then if the frequencies be the same, the fields will revolve at the same speed, and there will be no tendency for the rotor to move. If, however, the frequencies are different, then the rotor will revolve in one direction or the other, according to which of the two sources has the higher frequency, the speed being such that one revolution of the rotor corresponds to two complete cycles.

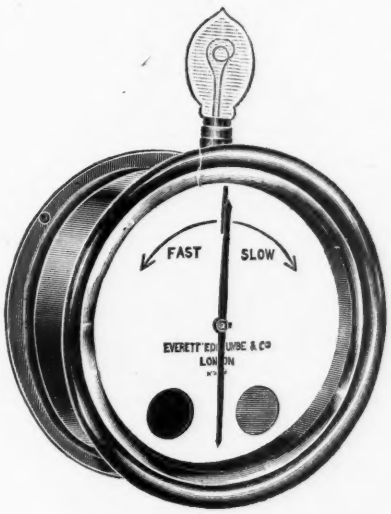


Fig. 1.

The rotor axle carries a pointer which revolves in front of a dial, and is so set that when the frequencies are equal, it stands vertical. In practice, in order to simplify the connections and to make the instrument applicable to single-phase systems, the necessary two-phase currents are produced by means of choking coils in two of the circuits and non-inductive resistances in the other two.

The method of connecting the instrument to a single-phase system is shown in fig. 2, from which it will be seen that only two transformers are required, and as the current taken is small (from $\frac{1}{2}$ to $\frac{3}{4}$ of an ampere), the ordinary synchronising or volt-meter transformers can be employed for this purpose.

In the case of polyphase circuits, the same instrument is used, and it has merely to be connected to one phase of the system, thus affording a considerable saving in the number of transformers required.

An important feature of the apparatus is the ingenious method by which the direction of rotation of the pointer is made visible at a distance from the switchboard, for example, at the engine. This is done by means of a movable vane, which obscures either a red or a green lamp, seen through an opening in the dial, according to whether the hand is revolving to the right or to the left. Thus the engine driver can see at a glance whether his engine is running too fast or too slow. Further, on the top of the instrument is mounted an ordinary synchronising lamp, from which he can see by how much his machine is out of step.

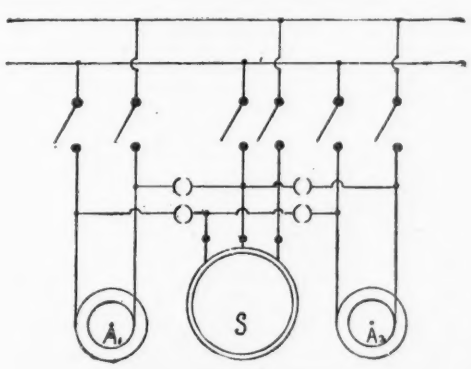


Fig. 2.

The instrument is usually constructed for 100 volts, and is provided with a dial some 8 in. in diameter. The apparatus is so simple that there would appear to be no likelihood of anything getting out of order. Altogether the device would seem to be a distinct step in the right direction, and in view of the ever-increasing size, both of stations and of generators, should be very extensively used in the near future.

LEGAL.

Societe Anonyme d'Electricite *v.* Friswell, Limited.

The hearing of this case was resumed on 18th inst., when Mr. Rufus Isaacs, after reading the correspondence, said that the question for the jury was whether the plaintiffs were entitled to deliver the cars after June 13th, 1900. As a matter of fact, all through the year 1900, and, indeed, up to June, 1901, the defendants were giving directions as to how they wanted the cars painted, &c., therefore it was quite out of the question for them now to raise the defence they did.

In reply to his Lordship, Mr. Terrell, for the defendants, said that he should rely on the pleadings for his defence.

Mr. Rufus Isaacs said that on the other point raised as to construction, he should call the Hon. C. S. Rolls, who was well known in the motor car world, and who would speak as to the completeness of the cars.

Mr. Haarbleicher, general secretary of the plaintiff company, was then called, and gave evidence as to the contract made with the defendants for the cars in question. The motor cars were up to the proper standard of construction.

Cross-examined: He was not aware that Mr. Friswell had tried the two Petit Duc cars in Paris. Mr. Friswell had made from time to time, complaints as to the construction of cars delivered to him.

Mr. Chas. Martin, examined, said he was foreman of the plaintiffs, employed in testing the cars. He tested the last two cars supplied to the defendants. He tested the last dogcart in July, 1900, by running it on the road between Versailles and Paris, a distance there and back of 20 miles. The dogcart ran most regularly. The starting movement and reversing gear were quite satisfactory. The brakes worked perfectly well. He tested the last Petit Duc car in November, 1900. It worked satisfactorily.

Cross-examined: Mr. Friswell never tried the dogcart in question nor either of the two Petit Duc cars.

The Hon. Chas. Stuart Rolls said he had taken a considerable interest in motor cars from the commencement of their use. He examined two cars of the defendants' in Paris, one a Petit Duc and the other a dogcart car. The dogcart started straight away, and the Petit Duc, after some dirt on the sparking plug had been removed, started immediately. Both cars ran satisfactorily. The speed of both was about 15 to 20 miles an hour.

Cross-examined: He only drove the cars for about a quarter of an hour.

Mr. Alfred Fredk. Bird, who accompanied the last witness on the trials of the cars, gave evidence as to the cars running well and satisfactorily.

Mr. Charles Friswell was then called, and examined by Mr. Terrell, said he drove the dogcart car in question in July last in Paris. Everthing went wrong, and they had to push the car back to the works, and then witness told plaintiffs he refused to take the car. He tried the other cars in June last, and finding they were old, worn-out machines, he said he would not take them.

Counsel having addressed the jury, and his Lordship having summed up, the jury returned a verdict for the plaintiffs on the claim and counterclaim. Judgment was entered accordingly.

Isaacson *v.* the New (Clapham) Grand, Limited.

This important action came before his Honour Judge Woodfall and a jury on Friday in the Westminster County Court by way of a new trial. It was a case in which parents sued for damages under the Employers' Liability Act for the loss of a son, who met with his death while working at the electrical plant at the New Grand Theatre of Varieties, Clapham Junction. Deputy Judge Horton Smith, K.C., held that deceased was not a workman within the meaning of the Act, and non-suited the plaintiffs, without calling upon the jury for a verdict. Application was then made for an award under the Workmen's Compensation Act, and Mr. Horton Smith, K.C., decided he was not a workman within the meaning of that Act. He also found that the place where he was at work was not a factory. Appeals have been before the Appeal and Divisional Courts, and there have been interlocutory proceedings in this Court. In one appeal it was decided to send the case back for a new trial, and in the other Court the proceedings stood adjourned pending the result of a new trial. The various hearings have been reported from time to time in the Electrical Review. Mr. Watson Moyses was counsel for the plaintiffs, and Mr. Minton-Senhouse for the defendants.

Mr. Minton-Senhouse took a preliminary objection on the ground that this action could not proceed while the appeal was pending.

His Honour held that the case should go on *de novo*.

Mr. Moyses said deceased was a very energetic young fellow of 23, and had won scholarships and certificates to the number of 23. He was employed by the defendants as electrical engineer at their premises where they produced electrical force for the purpose of lighting the theatre. The Deputy-Judge had found he was too

skilled to be a workman, but the contention was that he was engaged on manual work and was a workman. He was engaged on manual work when he met with his death. The process of blowing down the boilers had been in progress, and he had helped by the direction of his superior—Mr. Rayner. Near where he was working there was a sump, and a solid cover had to be moved when the blowing down was on. He was pulling a rod out of a boiler tube when he stepped into the sump and was scalded to death. The evidence would be to the effect that the sump was defective, and that the defendants were negligent by the fact of Mr. Rayner not having it remedied. Further, it would show that deceased had to do a thousand and one jobs that required manual labour.

Mr. and Mrs. Isaacson gave evidence as to pecuniary loss, the wages of deceased being 2 guineas a week.

Frederick William Rayner, A.I.E.E., said he was superintendent of the electrical plants at the company's various theatres. Isaacson was a practical engineer, and was engaged by him to "run the plant" at Clapham. Witness detailed the many acts of manual labour the position entailed. There should have been a grating instead of the solid cover, and then it could have remained over the hole. The sump was in a dangerous position.

Joseph Owner, one of H.M. inspectors of factories, and Charles Cooper, consulting and electrical engineer, agreed that the sump was in a dangerous position.

His Honour upheld the contention of Mr. Senhouse that there was no negligence, and no case to go to the jury. He therefore dismissed the jury and non-suited the plaintiffs.

Mr. Moyses pressed that the case was sent back for the purpose of getting a verdict from the jury, not only as to whether the deceased was a workman, but as to whether there was a defect in the plant, and whether there was negligence.

His Honour said he held there was no case to go to the jury.

Mr. Moyses applied *pro forma* for an award under the Workmen's Compensation Act, and asked for stay of execution for leave to appeal.

His Honour adjourned the application under the Workmen's Compensation Act, and granted leave to appeal with reference to his decision under the other Act.

Berrenberg Electric Lamp Syndicate, Limited, *v.* Lowden.

This case came before Mr. Justice Bruce and a common jury in the King's Bench Division on 20th inst. The action was brought by the plaintiffs to recover from the defendant £49 15s., the balance of a sum alleged to be due for electric lamps sold and delivered to the defendant. The defendant, by his defence, alleged that the terms of dealing were not those alleged by the plaintiffs, and alternatively that the lamps sold by the plaintiffs to him were sold with a warranty, and that the lamps so sold were not in accordance with the warranty. The defendant claimed, therefore, that he had a set-off against the plaintiffs' claim, and counterclaimed for damages for alleged breach of warranty. Mr. Wills appeared as counsel for the plaintiffs and Mr. Knight for the defendant.

Mr. Wills, in opening the case, said that the plaintiff company was formed in the year 1898 for the purchase of a patent which had been taken out by a gentleman named Berrenberg, the patent being of a pump for the purpose of the exhaustion of air in electric lamps. Mr. Berrenberg sold the patent to the company, and was a large shareholder in the company. The company carried on business from 1898, down to the date when they entered into negotiations with the defendant in or about October, 1900. At that time the defendant obtained an introduction to the plaintiff company, and entered into negotiations with them for the purpose of becoming an agent of the company for the sale of their goods. Defendant desired to have the sole agency in London or some district for the sale of the company's goods. That, however, the plaintiffs were unable to grant, but the negotiations went on, and ultimately it was arranged that the defendant having some customers of his own for lamps, should purchase them from the plaintiffs upon certain terms agreed between the parties. Accordingly there was a certain sliding scale as to price arranged according to the quantities of lamps purchased from the plaintiffs by the defendant. Between October 2nd, 1900, and January 28th, 1901, a number of deliveries were made to persons upon orders given by the defendant to the plaintiffs, amounting in all to a sum of £59 12s., or thereabouts, on account of which only a small sum had been paid, and against which there were one or two credits, making the plaintiffs' claim altogether to £49 15s. The last delivery was on January 28th, 1901. During the time when the deliveries were taking place the defendant made a few complaints to the plaintiffs with regard to the lamps supplied, but that was a thing which always happened in regard to these things. When lamps were returned on the ground that they did not burn properly, the plaintiffs supplied fresh ones. On January 28th the defendant had paid nothing to the plaintiffs in respect of the lamps he had had, and accordingly in the month of February a demand was made upon defendant that he should pay the sum of £53 0s. 8d., the amount due on the invoice, lent to the defendant by plaintiffs. A meeting took place between Mr. Rose, the manager of the plaintiff company, and the defendant, in order to discuss the payment of the account by the defendant. Defendant then made some complaint about the character of lamps supplied, and he told Mr. Rose he was not in a position to pay the money. Mr. Rose, on behalf of the company, agreed that if the defendant would pay £5 down and would pay £20 more by the end of June, there would be an end to all questions between the parties. The defendant did pay the £5 down, but never paid the £20, and therefore the arrangement came to an end, and therefore the plaintiffs claimed to have the amount sued for. The plaintiff company did not do very well, and on June 14th, 1901, a receiver was appointed on behalf of debenture-holders. Mr. Wilson was appointed receiver, and on two occasions defendant called on Mr. Wilson with regard to the payment of his account, and made offers of £10 and other offers in settlement, which, however, Mr. Wilson declined to accept. At that time no suggestion was made that the defendant had a counterclaim with regard to the quality of the lamps supplied. Under these circumstances the receiver obtained leave to bring this suit, in order to collect the money due from the defendant to the company. The main issue the jury would have to try was whether any damage was caused to the defendant by reason of the quality of the lamps supplied by the plaintiffs.

Mr. John Howard, Agent-General for Nova Scotia, residing in Pall Mall, examined, said he was managing director of the plaintiff company from 1898 to early in 1901. He remembered the defendant calling upon him about October, 1900. Negotiations took place by letters and orally with regard to the defendant becoming agent for the company, but defendant was never appointed agent to the company. It was arranged that if lamps were supplied to the defendant he was to get a varying range of discounts according to the number of lamps he took within one year, and that the defendant would be responsible for the payment of those lamps to the syndicate. In fact, the defendant was to act as a buyer and not as agent to the company. Witness received numbers of orders for the lamps from the defendant between October, 1900, and the end of January, 1901. The amount of the claim on the writ was correct.

Cross-examined: During the time that defendant was supplied with the lamps he made certain complaints about the efficiency of the lamps, and there were complaints from other people besides the defendant. Some of the lamps supplied to the defendant were wrongly marked "100 voltage." That was a pure mistake. Where there was a complaint about the lamps others were supplied. Where a lamp was returned credit was given for it to the defendant.

Re-examined: All the time that the defendant was making these complaints he was going on giving fresh orders for those goods.

Mr. Thos. A. Rose, examined by Mr. Wills, said he was a consulting electrical engineer. He was appointed manager of the plaintiff company in February, 1901; that was after the last consignment of goods to the defendant in January. On behalf of the plaintiff company he had an interview with the defendant on May 14th, 1901, as to his account. Defendant then complained about the lamps, and offered to pay £20 in settlement of his account. Witness offered to take £25, and it was then arranged that defendant should pay £5 down and the balance at the end of the following month. Defendant paid the £5 down, but did not pay the remainder.

Cross-examined: When he became manager, to a large extent, the business of the company was disorganised, owing to the inefficiency of many of the lamps sent out. The ordinary price of the lamps on the average, taking them all round, was about 11½d. each to the trade. He sold about 54,000 of the lamps for £550, or about 2¼d. each. The Berrenberg pump was working all right when he was there.

To his Lordship the Witness said that he sold the 54,000 lamps because they were inefficient.

Cross-examination continued: Sometimes the pump was inefficient and sometimes not. He understood, before he went to the company, that the company were experimenting with the filaments. That was not while he was there. He made his own filaments. He could not say what was the matter with the lamps in question, because the lamps were not made during his time. The defendant complained to him that he was losing his customers by reason of the lamps being bad.

Re-examined: When he went to the company it was suffering from want of capital. That was a serious thing for a company.

Mr. Knight: You did not expect us to find capital, did you?

Mr. Wills: Your time for making a speech has not yet arrived.

Re-examination continued: The defendant could not specify any customers that he had lost through the inefficient lamps supplied to him. In every make of lamp you expected at least 2 to 3 per cent. of inefficient lamps. Some makes ranged up to 10 per cent. or more. The average price of an English-made lamp was between 9d. and 10d. They were more expensive than foreign-made lamps. Foreign-made lamps ranged from 4d. upwards.

Mr. Edward Parker Wilson examined, said he was an accountant, and was appointed the receiver on behalf of the debenture holders of the plaintiff company. As such receiver he sold the stock of the company. He sold the 54,000 lamps for £550, but they were sold without any guarantee at all. He sold the plant and machinery of the company for £6,250. He carried on the business of the company for eight months in order to try and sell it as a going concern. Defendant called on him, and said he could not pay his account, but offered £10. Witness refused to take it. Defendant then said: "You can do what you like; you cannot make me bankrupt, as the amount is under £50." Witness replied, "the costs will soon make it up to that amount."

His Lordship suggested at this stage that the parties should endeavour to come to terms.

Mr. Wills said that he was willing to stand by the arrangement made in May, when the matter was discussed between the parties.

His Lordship: What do you say, Mr. Knight?

Mr. Knight: My counterclaim is a large one.

His Lordship: Oh, your counterclaim! I should think that the amount your client agreed to pay would meet the case; you both agreed to it then. It seemed a fair compromise to both parties at that time. We shall spend a lot of money and time in determining the matter. The amount in dispute is not worth half the money you are spending on it.

Mr. WILLS: Well, that is the offer we make. We offered to have the case tried in the County Court.

His LORDSHIP: A very proper case for the County Court. Well, go on, probably you will regret it.

Mr. WILLS: Well, that is my case, my Lord.

Mr. KNIGHT then opened the defendant's case. He said the plaintiffs had prosecuted the claim in a very peculiar manner. The statement of claim alleged that the defendant was a commission agent in the employ of the plaintiff company, but their witnesses proved that he was nothing of the kind. He would not, however, raise any point on that, but would be content to rest his case on the merits. The complaints that the defendant made about the lamps to the plaintiffs were both many, persistent and serious. The defence to the claim was, that the lamps sold to the defendant were so inefficient as to be worth nothing. If the jury were satisfied that that was so, they must find a verdict for the defendant on the claim. Out of the £69 worth of goods supplied by the plaintiffs to the defendant, £36 worth had not been paid for by his customers. Defendant could not sue them, because he had guaranteed lamps more valuable, and they proved otherwise. On this head the defendant counterclaimed for £31 12s. 3d., and also for a further sum of £15 16s. 1d., the discount or profit he would have made if the goods had been all right. Defendant then made a general claim for damages by reason of the loss of his customers.

Mr. LOWDEN, the defendant, examined, said that when he saw Mr. Howard for the first time, Mr. Howard told him that the lamps were the best in the world. He told Mr. Howard that he had a valuable connection, and could probably sell 100,000 lamps in a year. The lamps which he sold to his customers were stamped with his name. Amongst the firms that complained about the lamps were the Hotel Victoria, the Metropole, the Grand, the Junior Army and Navy Stores, and many others. Every time he got a complaint he went down to see Mr. Howard. Altogether he obtained 83 customers to take the lamps, and all were large consumers of electric light. Witness got orders from these people because he told them that he had got the best lamp in the world. All but two of them were dissatisfied with the lamps.

Cross-examined: The lamps were 2½-watt lamps—that was to say, they were able to make a candle-power with 2½ watts. That was economical. He had lost several customers through the bad lamps supplied to them by him. Plaintiffs had asked him to go round to his customers and collect all the lamps which were said to be inefficient. Of course, he would not do so. Inefficient lamps such as these were worth nothing, and when they were no use, customers would throw them away.

Mr. WILLS: Is there not platinum in them?—Yes, but about half a farthing's worth.

We often see in the electrical papers advertisements from people offering to buy old or disused lamps?—Yes, but not such lamps as these. Ediswans would probably have 3d. worth of platinum in them.

WITNESS, further cross-examined, said he had nothing but complaints from the people and firms using the lamps, and this caused him much damage with his customers.

Other evidence being given in support of the defendant's case, the jury eventually returned a verdict for the plaintiffs on the claim for £24, and for the defendant on the counterclaim for £15, and judgment was entered accordingly with costs on the High Court scale.

THE CYCLONE THEORY OF MAGNETISM.

By HENRY E. P. COTTRELL, A.M.I.C.E.

THE electro-dynamic phenomena investigated by Ampère in the first quarter of the nineteenth century, which led to the formulation of the solenoid theory of magnetism, have been during the last decade advanced several steps further by Mr. C. L. Weyher, whose name is well known in connection with investigations in meteorology, and especially into the genesis of cyclones, waterspouts, and circular storms. One of the most interesting exhibits in connection with the French Science Section of the late Paris Exhibition was that made by Mr. Weyher of working models illustrating his theory of cyclones and of magnetisation. Anything that tends to elucidate the action of currents on the ultimate particles of the conductors through which they circulate or the masses of metal which they affect is most valuable, because of its possible bearing upon the devices by which electrical energy is controlled and utilised, and no apology is required for directing the attention of your readers to Mr. Weyher's experiments and the inferences to which they give rise. Ampère's theorems on electro-magnetism are too well known to require recapitulation. Suffice it to remark, that the very numerous and extended experiments upon which these theorems were based afforded what has been accepted ever since as conclusive proof of the correctness of the postulates on which they were based, and of the deductions made therefrom. This correctness has never been challenged, and the vast advance made since Ampère's day in all matters connected with electricity has only served to confirm it yet further. The propagation of electrical waves in spirals rotating in a constant direction around the rectilinear axis of motion, was also indicated by Arago's experiments with soft iron wire conductors, whereby these conductors were turned into limited solenoids with magnetic properties analogous to, if not identical with, solenoids proper and magnetised bars. These properties, when viewed in the light of Mr. Weyher's experiments, afford a ready explanation of many of the obscure phenomena discovered and investigated at that period—*e.g.*, the mutual attraction of currents proceeding in similar directions along parallel conductors, and their repulsion when proceeding in opposite directions. But this will become clearly evident when Mr. Weyher's experiments have been described more fully. These in their inception were simply extensions of experiments undertaken to reproduce the meteorological conditions attendant on all cyclonic motions in the air, and inferentially in any other mobile medium, gaseous or liquid, and were, indeed, suggested by the latter. Motion of a cyclonic character can be readily set up in any medium of a mobile character by simply revolving cylindrical, spherical or disc-shaped fans provided with fixed vanes mounted on a shaft. All these fans are endowed with the common property, when revolved, of taking in air along the axis of revolution, and

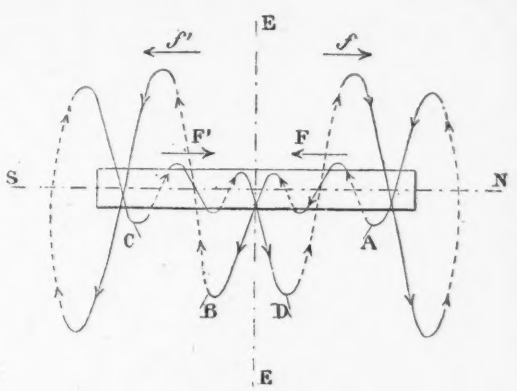


FIG. 1.

giving it out around the periphery of the vanes, that is, receiving it at their poles, and expelling it at their equator. These fans, for the purpose of experimentally studying the cyclonic motions to which their revolutions give rise, can be constructed of the flimsiest materials. Wooden rods of the size of pencils form the shafts, and ordinary cardboard or thick paper the vanes, and Mr. Weyher's models in the exhibition were merely glorified samples of these simple and inexpensive contrivances. If the cyclonic motions in the air, set up by a revolving fan of a cylindrical or elongated shape, be studied by means of small pieces of gold leaf let fall in its immediate vicinity, it will be seen that these are caught up and made to approach the nearest pole of the revolving axis along a spiral contracting path, which is followed till the middle section of the revolving fan is reached.

This spiral path is still followed in the same direction after the middle section is passed, but instead of contracting it then expands, till a certain outward limit is reached. Here the direction is reversed, and the motion is now continued along a contracting spiral path towards the middle section of the fan, the same cycle of change in the character of the spiral recurring when that section is once more reached, and so on indefinitely, as long as the bits of gold leaf continue moving under the influence of the air currents set up by the revolving fan. This will be readily understood by reference to fig. 1, representing a fan, N, S, revolving in the opposite direction to the hands of a watch, A, B, C, D, A, being the path of one of the pieces of gold leaf, which first follows a left-handed and then a right-handed spiral (as indicated by the arrows) around the axis of revolution. The number of possible paths is practically infinite, all of them turning in a similar fashion around the axis of motion, N, S, of the fan, and criss-crossing each other in the directions indicated by the arrows, F, *f*, F', *f*, within certain limits at

every imaginable distance from the axis, and at every imaginable angle of inclination to that axis between the extreme positions of parallel and normal. The directions on each side of the middle section or neutral zone are, be it noted, in every case symmetrically opposite. These spiral paths at each intersection mutually avoid each other, and probably behave in so doing like Lord Kelvin's vortex rings, which, when their paths intersect and contact occurs, suffer a slight deflection, oscillate about their axis of form, and proceed on their way in all other respects unaffected by the impact. These oscillations about the axis of form in the case of the vortical air currents in question give rise to transverse vibrations similar in number to the intersections, that is to say, infinite. Mr. Weyher remarks: "A phenomenon here occurs in space analogous to that which can be observed on the plane surface of a sheet of water when stones are thrown in from different directions; each stone gives rise to waves which are propagated concentrically around it; at each intersection of the wrinkles of a given wave with those of a neighbouring wave the water

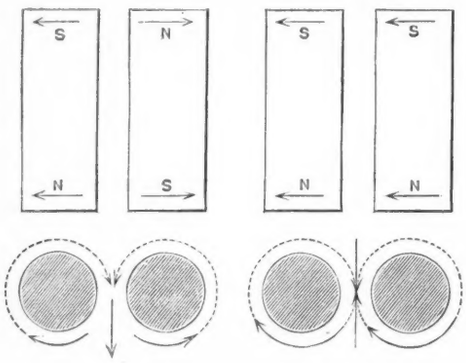


Fig. 2. Fig. 3.

is raised, then lowered, in level, this double movement of vibration being produced as many times as there are intersections, that is, in infinite number. If a great number of stones are thrown in different places at once, presently only an indecipherable agitation can be distinguished on the surface of the water, which appears to obey no precise law, and yet the concentric waves arising from each individual stone are actually propagated, widening their circles indefinitely without the others being able to check their course or interfere with their regularity. This can readily be discerned when one of these waves happens to outstrip its neighbours and reaches the shore, to die out, or, rather, to be reflected therefrom."

But to return to Mr. Weyher's experiments bearing on magnetic phenomena. The character of the dynamic field delineated in fig. 1 can be readily understood by constructing a model with narrow strips of tin bent to the required spirals and soldered at the ends, forming a complete and uninterrupted presentment of four opposite vortices.

Two of these models are threaded on wooden rods, arrows are affixed at suitable intervals to indicate the direction of motion, and a glance will show that attraction must take place when the spirals facing each other move in the same direction, and repulsion when they move in the opposite direction. In the first case, as the air flows in the same direction as the fans revolve, it is abstracted from the space between them faster than it is able to flow back, the pressure is diminished, and the fans, if free to move, must necessarily be caused to approach each other (see fig. 2). In the second case (see fig. 3) the reverse occurs; the air is heaped up between the revolving fans faster than it can flow away, the pressure is increased, and they are caused to diverge. Figs. 2 and 3 may be taken to represent either two revolving cylindrical fans or two bar magnets N, S and S, N, and it will be seen that the phenomena of attraction and repulsion in the two cases are identical. Fig. 4 represents two cardboard cylinders with distinctive colours at the poles, and additional arrows indicating the direction of flow in both magnets and revolving fans, by means of which Mr. Weyher's experiments can be more readily followed.

The simple mechanical apparatus delineated in figs. 5, 6 and 7, by which Mr. Weyher reproduced with his revolving cylindrical fans the various details of the proof of what may be called the first law of magnetism, viz., that poles of the

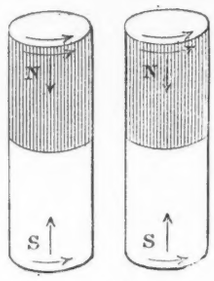


Fig. 4.

same denomination repel, while those of different denominations attract, is sufficiently explained by the figures themselves. The actual size is evidently immaterial, but in the exhibited models the rods were of the size of a pencil, there were six paper vanes 12 in. long by $1\frac{3}{4}$ in. to 2 in. wide, and the fans were driven from a small dynamo by a thin string off small pulleys on the rod ends, the latter being provided with

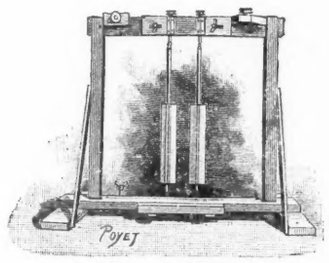


Fig 5.

a universal joint below the points of suspension, so that the fans hung like freely suspended pendulums. Guide pulleys to reverse the motion, and a holder and rest to revolve one of the fans at right angles to the other were also provided. If the fans arranged as in fig. 5 are revolved as shown diagrammatically in fig. 3, mutual repulsion is evolved, the divergence increasing with the speed of revolution. The fans behave exactly as bar magnets would do under similar circumstances. If the direction of motion in both fans be reversed, repulsion still occurs as if the magnets had been turned upside down. If one fan is revolved in one direction

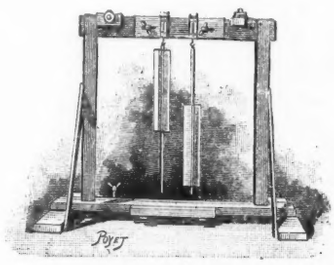


Fig. 6.

and the other in the other, the fans are attracted just as two magnetic bars under the conditions in fig. 2 would be. Reversing in both again does not affect the result. In fig. 6 one of the fans is constructed so as to slide along its axis to enable the lower extremity of the one to be brought on a level with the upper extremity of the other. On being rotated as before, they again behave precisely as two bar magnets under similar circumstances will do. Fig. 7 shows the arrangement by which the fans are rotated at right angles, the vertical fan only being free to move. Here,

again, if the two fans are suitably rotated so that two N ends or two S ends are opposed, repulsion occurs, and the vertical fan moves away from the horizontal; while if N is opposed to S or S to N, the reverse takes place again as with magnets.

By revolving the fans sufficiently slowly occular demonstration of the identity of their behaviour with the rule laid down for magnets under Ampère's law can be readily obtained.

The second law, by which every fragment of a magnet possesses identical properties with the original magnet itself,

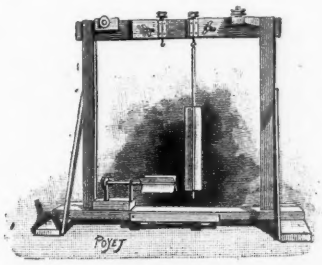


Fig. 7.

irrespective of size, can be readily proved with the revolving fans, by removing any desired proportion of the vanes and repeating the preceding experiments.

The third law, by which the locus of maximum magnetic attraction and repulsion is indicated as situated some distance within the ends of a magnet, and not at the actual extremities, can readily be seen to be absolutely parallelled in the fans. For in these the streams of air directed centripetally are not taken in exclusively at the ends, but also in a diminishing degree along the periphery towards the centre. From this it follows that the maximum centripetal effect must necessarily lie at some distance from those ends, as in a magnet.

(*To be continued.*)

WORKMEN'S COMPENSATION.

With reference to this extraordinary Statute (Workmen's Compensation Act, 1897), the members of the Court of Appeal might well say "Like the poor, it is with us always." In spite of the final determination of a number of vexed questions by the House of Lords, new points continually arise owing, in the first place, to the peculiar want of art which was displayed in drafting the more important clauses, and, in the second place, to the fact that employers, or the insurance companies who represent them, are so nearly affected by the terms of the Statute, that they are anxious to avail themselves of every loophole of escape.

It would be impossible, in the space at our disposal, to give any lengthy account of the cases which have recently been heard in the Court of Appeal. The following summary, however, may serve to emphasise some of the points which have lately been decided.

The text of the Act is so well known by this time to employers, that there is little need to explain it at length.

(*a*) *Who is Entitled to Compensation?*—The Act applies essentially to workmen, and a meaning to this term was given in the case of Evans *v.* The Penwyllt Dinas Silica Brick Company [18 T.L.R., 58]. There the applicant was a quarryman employed under a written agreement on the terms that he should be paid so much for every ton of material which he worked. He used to hire the men who worked under him, and discharged them. The County Court Judge found, as a fact, that this man was a workman within the meaning of the Act, and awarded him compensation for an accident. This decision was affirmed in the Court of Appeal.

(*b*) *When is a Workman Entitled to Compensation?*—Practically the only accidents for which an employer is not bound to make compensation are those occasioned by "serious and wilful misconduct on the part of a workman." This again is a question of fact for the County Court Judge. In two recent cases we have valuable illustrations of what is *not serious and wilful misconduct.*

A boy was working at a machine used for cutting screws. He leaned over a circular saw, which was in motion, to pick up an uncut screw which had fallen from its place, and, in doing so, injured his finger. He had been frequently told not to put his hand across the saw. The County Court Judge found that, though he was negligent, he was not guilty of serious and wilful misconduct. The Court of Appeal upheld this decision. [Reeks *v.* Kynoch, 18 T.L.R., 34.]

Again, in John *v.* Albion Coal Company (18 T.L.R., 27), a miner was killed in a colliery by a "journey" of trams while he was going from his work along the main haulage road upon which the trams ran. The miners employed in the colliery always left the mine by this road. There were manholes at intervals along the road, and on the day in question, the deceased man was warned by a fellow workman that the "journey" was coming near, and that he should get into a manhole. The deceased did not do so, and was killed. The County Court Judge, having found that the accident was caused by the serious and wilful misconduct of the deceased, held that there was evidence upon which he could so find.

3. *What Class of Employment Comes Within the Act?*—Broadly speaking, only those who are employed on, in, or about a mine, factory, or engineering work, or a building over 30 ft. high in the course of construction or demolition are entitled to claim compensation. The term factory includes a "warehouse." In the case of Wilmott *v.* Paton (18 T.L.R., 48), it has been held that the term warehouse does not merely apply to a place contiguous to water. It was also decided in that case that with regard to premises used for the purpose of breaking up old iron by a heavy weight which was raised by a mechanical appliance moved by hand, there was evidence upon which the County Court Judge could find that the premises were a "warehouse." Hence a workman injured in the course of his employment in such a place, was awarded compensation.

The term "factory" also includes every "dock, wharf and quay." Much difficulty has been experienced in arriving at a correct definition of the terms "wharf and dock." The unwritten rule which now appears to be followed in all cases of difficulty may be said to be that if there is a doubt whether a particular structure is a dock or a wharf, the benefit of the doubt is given to the workman. The opinion of the County Court Judge is final on the point. Thus in Cattermole *v.* the Atlantic Transport Company (18 T.L.R., 102), it was held that employment on a ship lying in a wet dock is employment in a factory within the meaning of the Act. The same principle was applied in Bartell *v.* Gray (18 T.L.R., 70). In the case of Ellis *v.* William Cory & Son (18 T.L.R. 28), a workman had been injured on a floating structure moored in a river, and having no means of communication with the land except by boats. It was used for the loading and unloading of cargoes. The County Court Judge held that the applicant had been injured in the course of his employment on a "wharf," and that he was entitled to compensation.

We have mentioned that the Act provides for compensation in case of injury to a workman employed in the construction, repair, or demolition of a building which exceeds 30 ft. in height, and in connection with which a scaffold is being used. Difficult questions have arisen as to the meaning of the term 30 ft. in height. In McGrath *v.* Neill (18 T.L.R., 36) a building under construction measured, at the time of an accident to a workman, over 30 ft. in height from the top of the footings above the concrete foundation, but if measured from the basement floor, the height would be under 30 ft. There was evidence that no more than the level of the building at the top of the footings had been covered in. The County Judge found that the building exceeded 30 ft. in height; the Court of Appeal refused to distort his finding, saying that the proper place to measure from was the level where the footings were covered in.

The term "scaffolding" has also proved to be difficult of interpretation, mainly because the judges decline to give the word its natural and ordinary meaning. For instance, in the case of Veazey *v.* Chattle (10 T.L.R., 99), the applicant had placed a ladder against a house over 30 ft. in height. On the roof of the building he placed a "crawl board" to enable him to reach the ridge. This erection, which, in our view, is very far removed from the ordinary notion of a scaffold, was held to be a "scaffold" by the County Court Judge at Derby. This view was supported in the Court of Appeal, but Lord Justice Stirling refused to take the view adopted by the other members of the Court.

In a case which was decided so recently as June 3rd, 1902, it was held that a man injured when working on a tramline is entitled to the benefits of the Act.

(*c*) *The Method of Estimating the Amount of Compensation.*—Here again extraordinary difficulties are experienced which continuous litigation for a period of nearly three years has not yet set at rest. The sum to be paid is based upon the average weekly earnings. It has been held that in order to arrive at the "average" weekly earnings it is not necessary that the workman shall have been employed for a full period of two weeks. In the case of Ayres *v.* Buckeridge (18 T.L.R., 20) the question arose as to how compensation should be assessed when a workman is employed by the hour and has to work so many hours a day. Thus in the case under notice a workman was engaged for 11 hours a day for five days in the week and five hours on Saturday. On the fourth day of his employment he was killed in an accident. The County Court Judge awarded compensation on the basis that the man's average weekly earnings were what he would have earned had he worked his entire number of hours in each week. The Court of Appeal decided that this finding was right, although there was nothing to compel the workman to work for the full number of hours in each week.

It is submitted that the cases which are considered above, afford indisputable proof of the fact that there is a tendency in the Courts to lean in favour of the workman. In doing so they dutifully follow the principles laid down in the cases which have reached the House of Lords. It is thus that the spirit of a badly-drafted Act is made applicable to one portion of the community at the expense of another.

But the legislature is not content to entrust the clandestine extension of the Workmen's Compensation Act to the executive. All unknown to the majority of commercial men, the Act has received considerable extension by means of the Factory and Workshop Act of 1901, which came into force on January 1st, 1902. As we have seen, the Compensation Act applies to such places as are

factories within the meaning of the Factory Acts. In the new Act, by Sec. 104, "every dock, wharf, quay and warehouse, and all machinery of plant used in the process of loading or unloading *of coaling* any ship in any dock, *harbour and canal*," is included in the definition of the work factory. The words in italics are new.

Further, the words loading and unloading formerly applied only to loading and unloading from or to a dock, wharf, quay or warehouse. They now apply to ships. This amendment involves a very material extension of the application of the Workmen's Compensation Act. But this is not all. A further amendment of the law, of considerable interest to electrical engineers, has been made. Hitherto electrical generating stations, not being included in the term factory, have only come within the Workmen's Compensation Act on the ground that they are "engineering works." Turning to the new Factory Act, we find that the term non-textile factory now includes —by Sched. VI., Pt. I. (20)—"electrical stations," that is to say, any premises, or that part of any premises, in which electrical energy is generated or transformed for the purpose of supply by way of trade, or for the lighting of any street, public place, or public building, or of any hotel, or of any railway, mine, or other industrial undertaking. Hence, if the stoker who looks after the fire which works an electrical plant in a large hotel suffers from the effects of an accident, he is brought, by back-handed legislation of an extraordinary character, within the provisions of the Compensation Act! This is one of the features of the new Factory Act. We anticipate that its proper interpretation will involve as much litigation as the Workmen's Compensation Act.

BUSINESS NOTES.

Arc Works War Funds.—The handsome sum of £508 has been contributed to the War Relief Fund for soldiers' and sailors' wives and families by the employés at the Arc Works, Chelmsford (Messrs. Crompton & Co., Limited), by weekly penny subscriptions.

Books Received.—"The Electrical Catechism," compiled from the regular issues of *Power*. New York: Hill Publishing Company. 1902. $2.00.

"Alternating Current Machines: being the Second Volume of Dynamo-Electric Machinery," by S. Sheldon and H. Mason. London: Crosby Lockwood & Son; New York: D. van Nostrand Company. 1902. 12s. net.

"Britain for the British," by Robert Blachford. London: *Clarion* Press, 1902. 3d.

Catalogues, &c.—Mr. J. Pitkin, of Clerkenwell, has issued a revised list R, giving prices and illustrations of his ammeters, voltmeters, cell testers, recorders, &c. A list of some of the central stations which are using Pitkin's instruments is given.

Messrs. Ch. Mildé, Fils & Cie., of Paris, have sent us price lists of their telephonic apparatus and bells. The former are arranged for both public and private systems, and are made in a great variety of designs, with all kinds of accessories. The latter comprise numerous forms of bells, indicators, pushes, batteries, insulators, &c.

Mr. G. Braulik, who is introducing a line of arc lamps of English manufacture, has sent us his new list giving prices and particulars of these. The main advantages claimed for these lamps are —moderate cost; they are strongly made and burn well; the working parts are few and easily adjusted; the lamp is of neat appearance, and all necessary repairs can be executed in England at short notice. The particulars embrace open type D.C. and A.C. lamps, burning for 12 to 18 hours; outside lamps for shop windows; enclosed type D.C. and A.C. lamps, together with carbons, resistances, choking coils and transformers, patent winch and coupling, &c. All the lamps are of the single-carbon focussing type, and can be arranged to burn in parallel or series.

Messrs. Mechan & Sons, of Scotstown Iron Works, Glasgow, who have been appointed manufacturers of Prof. Watkinson's patent appliances for superheating steam, &c, have sent us a fly-sheet, drawing attention to the advantages of their "British Steam Superheater." This is constructed entirely of mild steel, the tubes being solid drawn, and due provision is made for expansion, &c. The Watkinson economiser, which acts by heating the air supplied to the furnaces instead of heating the feed water, is also described.

We have received from the Howard Conduit Company, Limited of Trafford Park, a copy of their latest catalogue, and also a small sample of their asphalt solid system. The catalogue is excellently illustrated, and describes their asphalt conduits, troughing, and accessories for underground mains. We learn that this system is now recognised by many authorities as an excellent system of insulation. The works are exceedingly busy, and extensions are in hand. Amongst numerous others the company's products have been, or are being, laid at the following places:—Windsor, Trafford Park, Bournemouth, Nottingham, Eccles, Lancaster, &c., and they have also secured the contract for one year's supply of asphalt troughing from the Salford Corporation, and that for the whole of the troughing for the Leatherhead electric lighting scheme.

Messrs. Veritys, Limited, have brought out a circular, No. 38, dealing with the Jewell moving coil instruments, which they are putting on the market as high-class moving coil instruments of great accuracy. Amongst the special features which are detailed, it is claimed that it is possible to adjust the scale without opening the instrument, another useful feature being that the pins are situated at points on the same horizontal diameter and the distance between their centres is constant for all sizes. This greatly simplifies the mounting of instruments upon boards.

A number of new lists have come to hand from the Sun Electrical Company, Limited, one dealing with their electric fans; another devoted to electric bells, indicators, &c., embodies a good range of all requisities necessary for this particular branch; one is a small list of telephones for private houses, hotels, &c.; while a small brochure catalogue of electric light fittings has been compiled specially with a view to making it useful to contractors when sending out their estimates, inasmuch as it embodies a good range of the cheaper class of fittings suitable for use throughout the house, and also includes a good many of the Sun Company's latest designs in æsthetic styles.

The Premier Electric Lamp Company, Limited, of Liverpool, are sending out circulars relating to their "Premier" glow lamps for which new and extensive works have been equipped at Huyton Quarry, Liverpool, with modern electrically-driven machinery. Some advice is given as to how to choose a glow lamp, and the good points of the Premier "Traction" lamp are mentioned. High and low voltage lamps, and lamps for street lighting and high candle-powers, also miniature lamps for decorative lamps are shown in the list. We understand that a number of important contracts for large installations are in hand, and that the "Traction" lamp is in demand by numerous electric tramway authorities.

Coronation Illuminations on the E.L.B. System.—We understand that the output of illumination material and devices on the E.L.B. system has exceeded the most sanguine expectations of the Electric Lighting Boards Companies. H.M. Office of Works has been using the E.L.B. system for part of the work at Westminster Abbey; it is applied throughout the Stock Exchange, and over the great façades of the Prudential Insurance Company and the Gresham Insurance Company. Of clubs using it there are the United Service Club, the Conservative Club, and the Devonshire Club. Along the Embankment there is an extensive display in the Temple Gardens. In the West End an exceedingly elaborate and clever display of the system is on the Hippodrome building, another on Messrs. Marshall & Snelgrove's big frontages, and another at Messrs. Liberty's premises in Regent Street. Among the various banking houses Lloyd's Bank and Martin's Bank are equipped with this system. Further, there are endless devices on the E.L.B. system applied to ordinary business premises in the City, in the West End, and also on quite a number of private residences in Mayfair. It is stated that the Electric Lighting Boards Company has, however, suffered through the Supply Company's heavy charges for connecting up, and we are informed that in no less than 170 cases have orders been cancelled owing to these charges being resented and gas hence being used in place of electricity. The short-sighted policy of certain supply companies has been detrimental throughout.

Dissolutions, &c.—The Telephonic Bell-Push Syndicate is winding up voluntarily. Mr. H. A. Wilson, of 39, Lombard Street, E.C., is liquidator.

Messrs. F. F. Bennett, A. W. Thomas, and J. W. Donaldson (Bennett & Ward Thomas, electrical engineers, Manchester) have dissolved partnership, and Messrs. Thomas & Donaldson will continue the business.

The G.E.C. Fire.—The directors of the General Electric Co. (1900), Limited, finding that an impression is prevalent that in consequence of the disastrous fire which occurred on the 9th inst., the company are unable to execute orders, wish to say that the large stocks held at their branches, and the exceptional facilities for manufacture at their various works, have enabled them to efficiently cope with the strain which the fire has put upon their resources, and all orders can be executed with promptitude. As, however, it is possible that some order sheets may have been lost, any customer noticing that an order placed by him has not been executed with the usual promptitude, should forward a copy.

Imports of Foreign Electrical Goods and Apparatus.—The monthly returns issued by the Board of Trade, so far as they relate to the imports of foreign electrical goods into this country, only give the aggregate total, no indication being given as to the country of origin of such imports. We have, however, been able to secure this information and append a table, showing the imports by countries during the past two years:—

Imports of Foreign Electrical Goods and Apparatus into the United Kingdom.

	1901.	1900.
United States	£388,181	£832,801
Holland	149,014	115,016
France	123,927	140,055
Belgium	87,242	76,712
Germany	74,214	86,951
Sweden	17,712	9,155
Other countries	8,967	5,256
	£849,257	£1,265,946

Outing.—A party of 50 of Messrs. W. T. Glover and Co.'s staff, who have been at work on one section of the Manchester contract went for an outing a few days ago to Tideswell, Derbyshire. Journeying by train to Buxton, the men drove to Tideswell, where dinner was served.

(*Continued on page* 1067.)

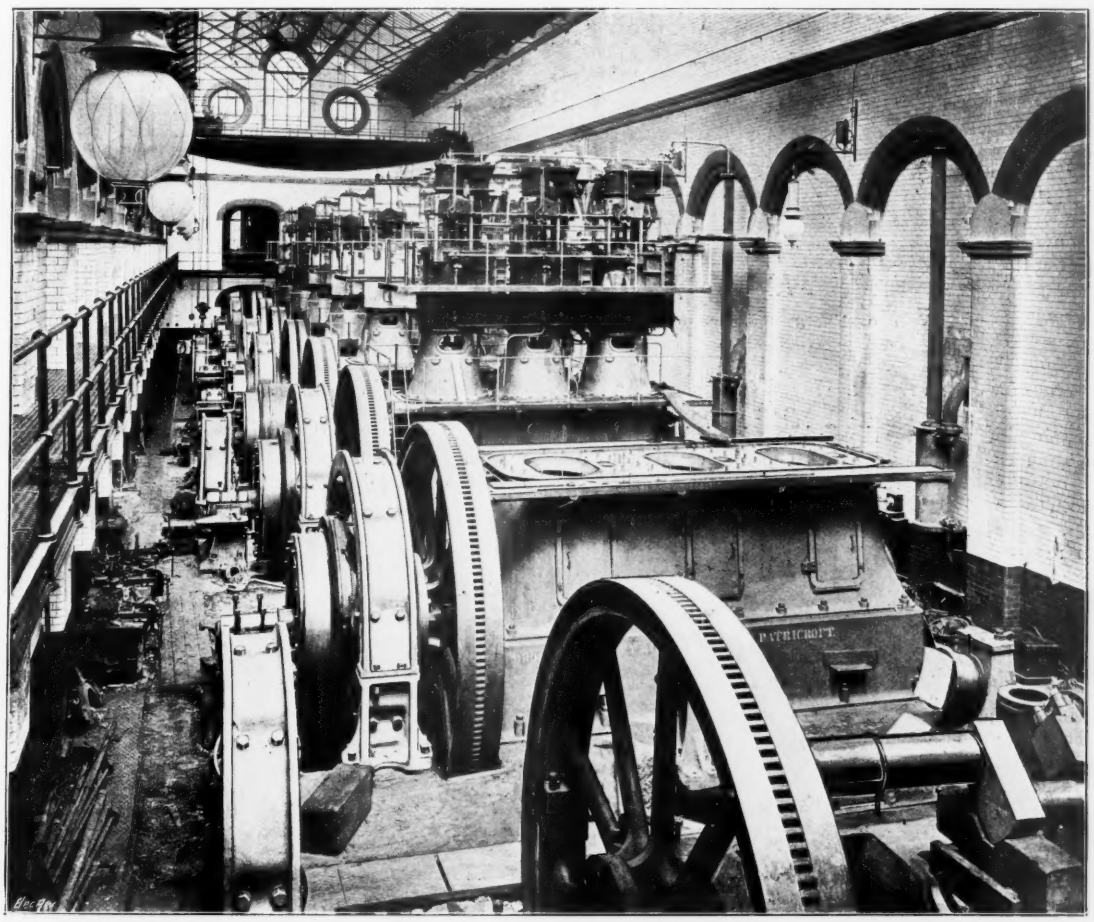
SALFORD CORPORATION ELECTRICITY WORKS AND TRAMWAYS.

The borough of Salford has possessed a tramway system since as long ago as 1874, and has supplied itself with electricity, on the high pressure alternating current system, since 1896; but the tramways were leased to a company until 1900. Before the expiration of the lease, the Council had come to the conclusion that it would be advisable not to renew it, but to take over the tramways and work them itself by electrical means; further, that the existing station, which contained generating plant of only 360 kw. output, supplemented by battery sub-stations, to feed a total connection equivalent to over 50,000 8-c.p. lamps, and had cost, with the mains, about £100,000, could not profitably be extended to cope with the rapidly increasing load.

Up to that time the fortunes of the undertaking had not been particularly happy; a considerable deficit had been shown in each year's accounts, though the fact that the amount to be provided from the rates was rapidly diminishing was of good omen for the future. The system, however, was defective; there was too much transformation, with its inevitable losses, and the Corporation was well advised when it decided to completely reorganise the undertaking, and at the same time to make due provision for the power required to operate the tramways.

In January, 1899, Messrs. Lacey, Clirehugh & Sillar were appointed consulting engineers, and were instructed to prepare designs and specifications for a new power station. A site was chosen on Corporation land in Strawberry Road, Pendleton, much nearer the centre of the area supplied, and on the bank of the Bolton and Bury Canal. The direct current system was adopted, with a declared pressure of 220 volts for lighting, on the three-wire system, which permitted power to be supplied to motors at 440 volts. The same generators are also used to supply power to the tramways at 500—550 volts.

Avoiding the error into which so many municipal undertakings of this kind have fallen—that of under-estimating the demand, and putting down plant which has to be extended before it even gets to work—the Corporation adopted Messrs. Lacey, Clirehugh & Sillar's estimates and designs for a station of 6,400 kw., presenting a striking contrast with the old station at Walness Road, which never contained plant of more than 500 kw.! Most of the plant is now in position, and the station has been at work for some months. The old station was shut down in May last.

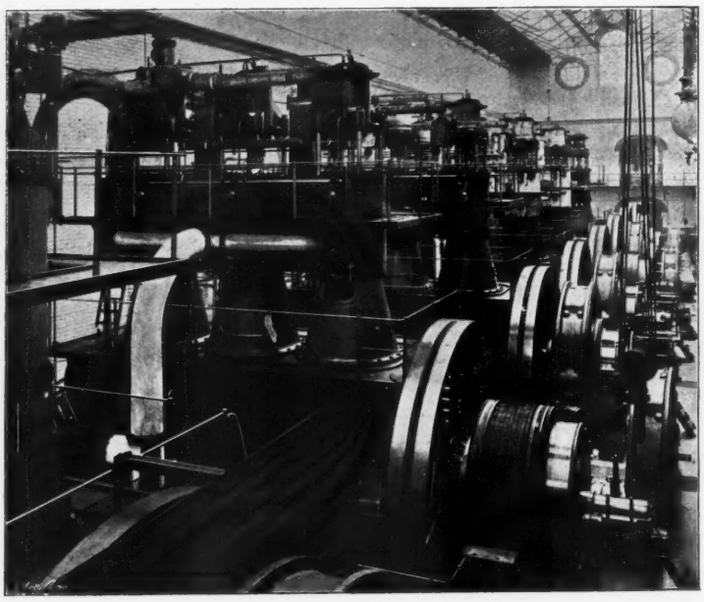


General View of Engine Room.

Mr. C. D. Taite, whose highly successful management of the Southport electricity and tramway undertakings, combined with his previous experience in other stations, amply justified the Council's choice, was appointed borough electrical engineer in January, 1901.

The new station is of the simplest possible design, consisting mainly of a boiler house containing a single row of boilers, and an engine room equipped with a corresponding and parallel row of generating sets. A chimney, economiser, and pump room are provided at each end, and the plant can be divided into two complete and independent

systems, in case of need. Annexed to the station proper is an extremely fine suite of offices, committee room, &c. The exceptionally handsome appointments and furniture of these



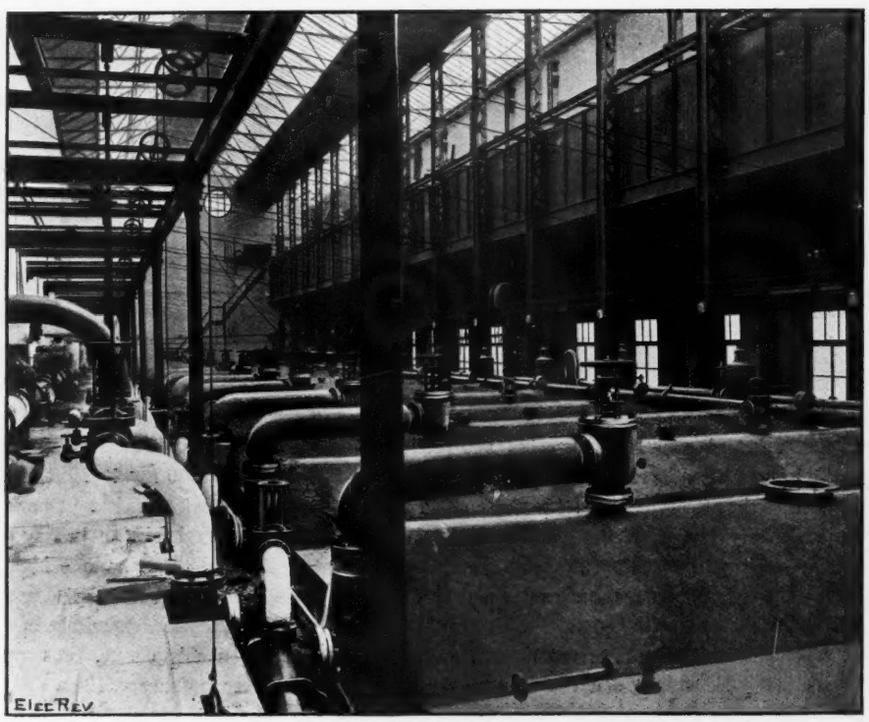
View of Engine Room from North End.

offices calls for special remark. It is a well-known fact that comfortable and refined surroundings exert an elevating and stimulating influence over those who work amidst them, and here again the Salford Corporation has shown itself to be in advance of many of its fellows by taking thought for men as well as things. The effect of impressive appearances upon the Council's customers ought also to be given its due weight in this connection, for sentiment enters even into business.

The boiler house is a spacious room, 221 ft. long, 56 ft. wide, and 44 ft. high, well lighted from the roof and freely ventilated. It contains 16 Lancashire boilers, with Galloway tubes, supplied by Messrs. Galloways, Limited. Each of these is 30 ft. long by 9 ft. diameter, and is fitted with a Musgrave superheater at the back end. The boilers are arranged in eight pairs, each pair feeding one engine, or supplying steam to the main range, as desired. They are fitted with coking mechanical stokers, supplied by Messrs. J. Hodgkinson, of Salford; we understand that these have proved very successful, with regard to both economy and smokelessness, while a noticeable feature is the remarkably small space which they occupy in front of the boilers, as shown in our illustration. The stokers are worked by an overhead shaft, driven by a Westinghouse motor. The steel boiler fittings are of Messrs. Galloways' make; the fittings on the front of the boilers were supplied by Messrs. Hopkinson.

Coal is stored in steel bunkers, extending the whole length of the boiler house, along the wall nearest the canal, and immediately over the stoking floor; the wall of the boiler house is practically flush with the canal bank. The total storage capacity is about 1,600 tons. The coal, which is Lancashire washed slack, is fed to the mechanical stokers by means of shoots, each of which is fitted with a measuring device of the gunpowder-flask type.

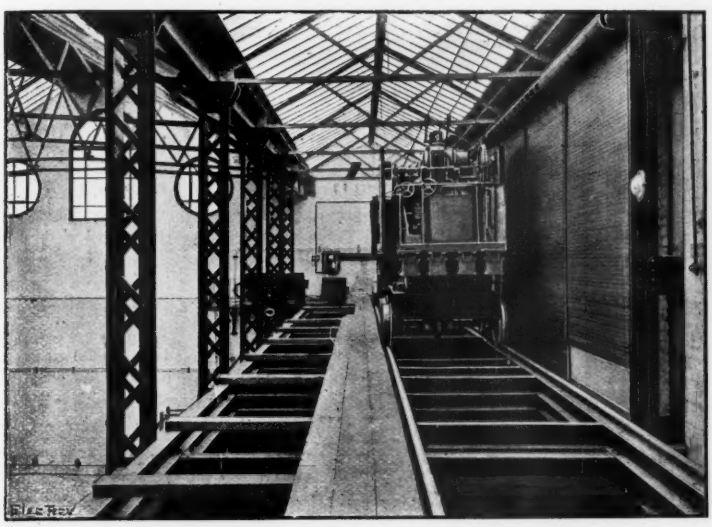
The coal supply arrangements are of a novel character, distinguished by their simplicity. Two electrically-driven jib cranes run on rails over the top of the bunkers; these swing out over the barges, in which the coal is delivered in boxes of 20 or 30 cwt., lift a box, weigh it, swivel so as to bring it over the bunker, and discharge the contents, the boxes being made with collapsible bottoms to facilitate the process. The side of the boiler house consists of open framework above the top of the bunkers, to enable the jibs to swing outwards; the apertures are closed with light iron screens when coaling is not in progress. Arrangements are being made to take up the coal with grabs, instead of having it delivered in boxes; the latter is a common Lancashire custom, but the former is said to be cheaper. The jib cranes were supplied by the Clayton Engineering Company.



View of Boilers and Superheaters, from South.

The ashes are raked from the ashpits of the boilers into hoppers, whence they fall through shoots upon an automatic ash conveyor of the continuous-plate type, driven by a Westinghouse motor; the conveyor takes the ashes to a

shoot which deposits them in barges on the canal. Thus neither the coal nor the ash is touched by hand from start to finish. The conveyor was supplied by Messrs. Graham, Morton & Co.

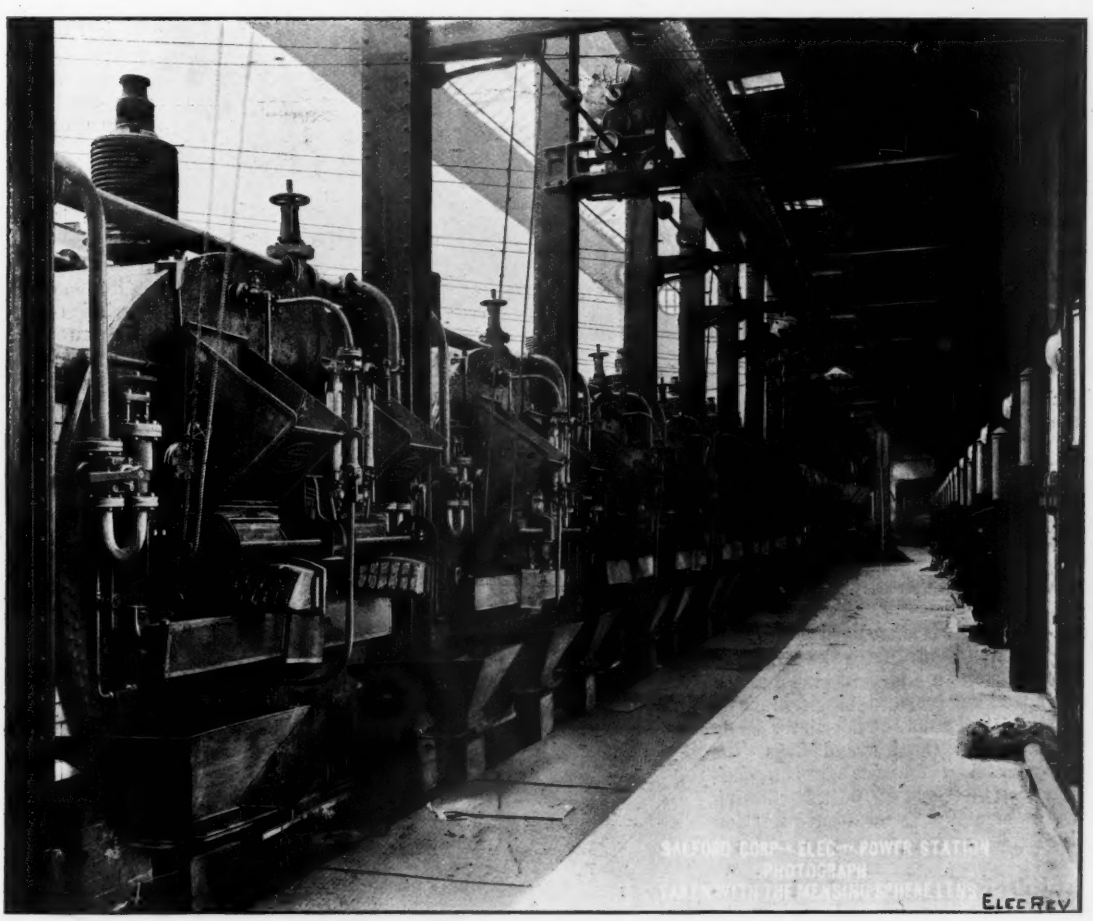


Electric Travelling Jib Crane, over Coal Bunker.

The economisers are four in number, two at each end of the boiler house, and are of the well-known Green type, comprising 400 tubes each. The scrapers are driven by two Lundell motors. From these the waste gases pass off direct to the chimneys, which are 200 ft. high and 13 ft. in diameter. Feed water is obtained from the canal, with the town mains as an alternative supply. Two tanks are provided, each of which is capable of storing 180,000 gallons. There are two pump rooms, each containing three electrically-driven feed pumps. The latter were supplied by Messrs. Bertram Thomas & Co., of Manchester, and are of the three-throw single-acting type, driven through worm gear by 20-H.P. electric motors; each pump has a rated capacity of 4,000 gallons of water per hour. The pumps feed into a common main, which delivers into a 4-in. feed water ring main, either direct or through the economisers.

The steam piping was carried out by Messrs. Sir W. H. Bailey & Co., Limited, and consists of steel, with copper bends; the flanges are of steel, riveted and welded. The pipes, &c., are covered with magnesia sectional lagging. The steam traps are partly Lancaster & Tonge and partly of the Geipel type; the separators were made by Messrs. Bailey & Co.

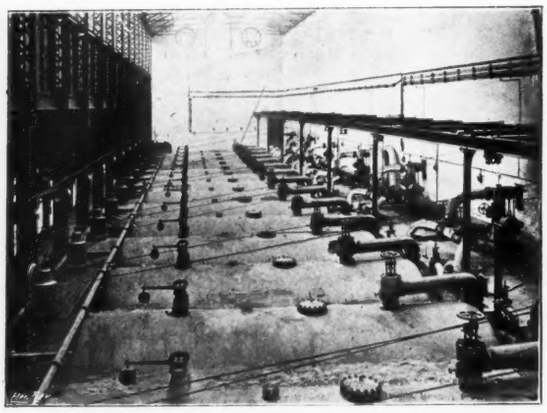
The superheaters are provided with bye-passes, and can easily be lifted out. The temperature of the superheated steam varies from 480° to 550° F., corresponding to a superheat of 110° to 180° F., the boiler pressure being 160 lbs. per sq. in.



Front View of Boilers and Automatic Stokers.

Each pair of boilers is connected direct to an engine by a pipe 8 in. in diameter; a vertical tee from this pipe joins

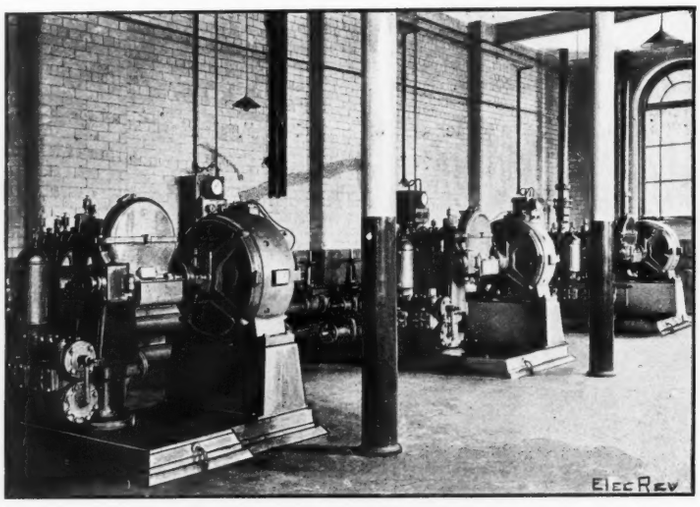
the boilers to a main header 14 in. in diameter, which can be used to connect all the boilers, or groups of boilers, in parallel. Three 10-in. copper expansion bends are inserted in the course of the main pipe.



Boiler House, from the North.

The extraordinary height of the boiler house, compared with that of the boilers, produces a strong impression upon visitors, and is an object lesson in the subject of water-tube *versus* cylinder boilers, from the point of view of the relative spaces occupied by these respective types.

The engine room, on the other hand, is well filled. After seeing so many British stations—even brand new ones—filled with assorted makes and sizes of engines and dynamos, it is pleasing to look along a row of eight sets, each of 800 kw., and all made by the same two firms; it is interesting to note also that both of the latter, as well as the makers of the boilers, stokers, condensers, pumps, cables and lighting switchboards, are local concerns.



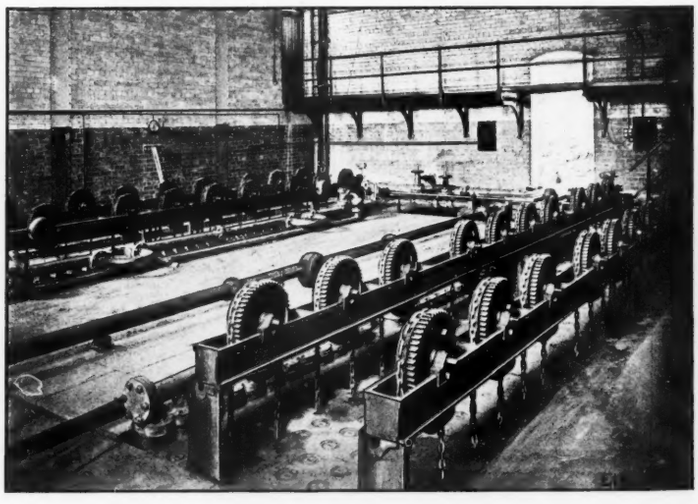
One of the Pump Rooms.

The engine room is lofty, lined with glazed bricks, and well lighted from the roof. It is spanned by a 30-ton single-motor electric travelling crane running on rails at a height of 34 ft. from the floor level, made by Messrs. Jas. Carrick and Sons. A gallery runs along one side and both ends of the room, at a height of 15 ft., facilitating the supervision of the generating plant and leading into the switch room at one end, the stores at the other.

Both the engines and the dynamos have been described in previous issues of the Electrical Review; a brief recapitulation of their leading features will not, however, be out of place. The engines were built by Messrs. Browett, Lindley & Co., of Patricroft, and are rated at 1,200 i.h.p. each at normal load, running at a speed of 100 revolutions per minute, with capacity to deal with an overload of 25 per cent. They are of the three-crank vertical tandem compound type, the high-pressure cylinders being carried by polished steel pillars above the low-pressure cylinders, in such a way that the covers of the latter can be raised when it is necessary to renew the piston rings. The low-pressure cylinders are mounted on cast-iron distance pieces, which contain the bored guides for the cross-head slippers, and are bolted to the top of the crank chamber. The latter is strongly ribbed, and is provided with hinged doors at both sides, to give free access to the interior. The baseplate contains the four main bearings, the largest of which, next the fly-wheel, is 14 in. in diameter by 32 in. long. The bearings are of gunmetal, lined with Dewrance's white metal. The crankshaft is of the built-up type, the crankpins being 13 in. in diameter; a 4-in. hole is bored through the shaft and pins. The cylinders are 15 and 32 in. in diameter, with a stroke of 30 in.; they are fitted with loose liners, and are jacketed, including the covers, with steam at boiler pressure. The high-pressure valves are of the piston type, the low-pressure balanced slide valves, all worked by eccentrics on the crankshaft. United States metallic packing is used in the stuffing-box of the high-pressure cylinder and the upper box of the low-pressure cylinder.

Forced lubrication is used to all parts of the engines, the oil being pumped through a filter by valveless pumps driven by eccentrics.

The governor is of the high-speed centrifugal type, driven by a chain at 400 revolutions per minute, and acting on a throttle valve; an auxiliary throttle valve, worked by the same governor, admits live steam to the low-pressure cylinder when overloads occur. An emergency governor shuts down the engine in case of any accidental excessive rise in speed. The maximum variation of speed between no load and full load is 2½ per cent. There are two platforms round the engines, and all the handles, stop valves, &c., are brought to one end of the frame.

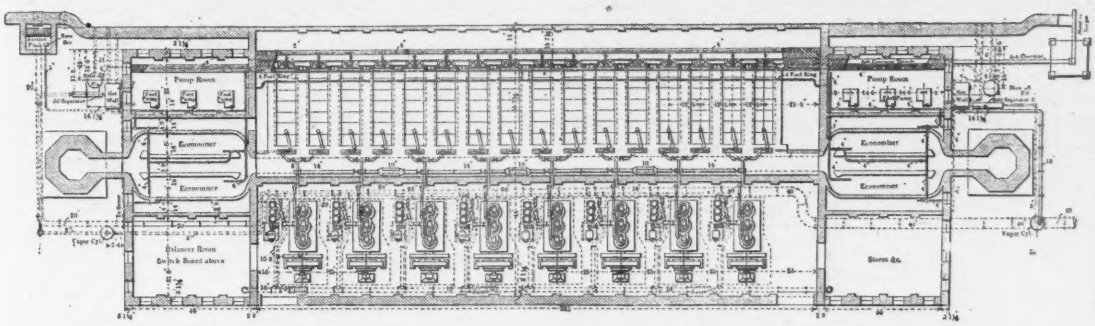


One of the Economiser Rooms.

The fly-wheel is 16 ft. in diameter, and weighs 18 tons. It is made in halves, strongly bolted and cottered together, and strengthened by steel rings shrunk on the boss.

Each engine is provided with a separator. The cylinders are lagged with asbestos, and smartly finished with planished steel.

A separate jet condenser is provided for each engine, with Edwards air pumps, the whole being supplied by Messrs. W. H. Bailey & Co. The pumps are of the three-throw

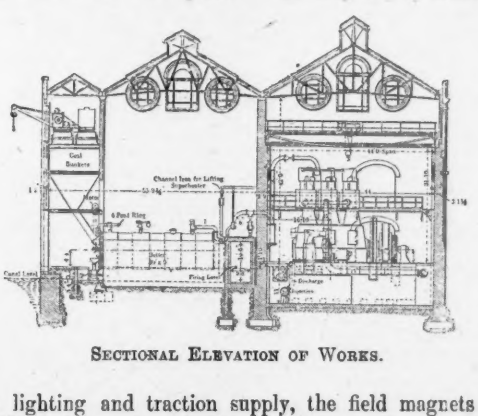


Plan of Salford Electricity Works.

type, with barrels 21 in. in diameter, and a stroke of 12 in. Each pump is capable of dealing with 18,750 lbs. of steam per hour, at a speed of 100 revolutions per minute, and is driven by a 50-H.P. motor, made by Messrs. P. R. Jackson and Co., Limited. The motors run at 600 revolutions per minute, and drive through double reduction gear. The pumps draw water from the canal through a suction pipe 20 in. in diameter, and discharge through a 40-in. pipe with six outlets.

The main exhaust pipe runs along the side of the engine room remote from the boilers, beneath the floor level, from end to end; it is of cast-iron, 18 in. in diameter, with 15-in. branches to the engines. The exhaust pipe is fitted with a valve at the mid-point, to divide it into two independent sections, and is led up each end of the building; it is fitted with three expansion joints, and each engine is provided with an automatic atmospheric valve.

Each engine is coupled direct to a generator built by Messrs. Mather & Platt, Limited, of Salford; the generators are rated at 800 KW. each at normal load, but will carry 1,000 KW. for a short period. As they are intended for



Sectional Elevation of Works.

both lighting and traction supply, the field magnets are provided with series winding. The normal pressure as shunt machines is 480 volts, and as compound machines 525 volts. The field magnets have 10 poles, circular in section, and bolted to the yoke, which is of cast-steel. The armature is of the slotted core barrel type, with ample ventilation; the core is built up on a double spider, one part of which carries the half-coupling, so as to relieve the shaft of torsional stress. The armature is 8 ft. 6 in. in diameter, and the shaft 15 in. The whole machine weighs over 50 tons, of which the armature constitutes one-half. Carbon brushes are used, carried by a star-shaped spider mounted on the outer bearing. Automatic lubrication of this bearing is provided. The efficiency of the generator is stated to be over 95 per cent., as tested at the maker's works.

(To be concluded.)

BUSINESS NOTES.

(*Continued from page* 1062.)

Plant for Sale.—The Manchester Electricity Committee announce the sale by tender (June 28th) of three vertical compound Galloway engines of 400-I H.P. running at 80 revolutions per minute, four 250-KW. shunt-wound dynamos, 400 revolutions per minute, with belts and jockey pulleys complete, now at the electricity works, Dickinson Street, Manchester.

Trade Announcements.—Messrs. Easton & Co., Ltd., have appointed Messrs. Reunert & Lenz, of Johannesburg and elsewhere, sole agents for the whole of South Africa for the sale of the Schmidt patent superheaters, and also for the sale throughout the same territory, except Cape Colony, of their electric and hydraulic lifts. In future, therefore, all communications with regard to either superheaters or lifts for the districts referred to should be addressed either to Messrs. Reunert & Lenz, or to their London representatives, Messrs. Findlay, Durham & Brodie, of 110, Cannon Street, E.C. Messrs. Easton have also engaged Mr. Francis G. Cowlrick, of 37, West Dulwich Mansions, S.E., as their representative for the South of England.

Messrs. James Russell & Sons, Ltd., of Wednesbury, announce that the Crown Tube Works will be closed for the annual stock-taking from June 26th to July 2nd, both dates inclusive.

We learn that the Standard Varnish Works are sending their electrical expert (Mr. John C. Dolph) to London to attend the Tramways Exhibition at the Agricultural Hall next week, and electrical engineers will be able to consult him during his stay here as to the superior points in regard to varnish insulation.

Willans Engines.—Messrs. Willans & Robinson have received an order from the General Post Office for four 250-H.P. compound engines for direct coupling to Siemens dynamos for the G.P.O. new savings bank at West Kensington. They have also received an order for two 360-H.P. compound engines for direct coupling to dynamos by Dick, Kerr & Co., for the telegraph factory, Mount Pleasant; one through Messrs. Dick, Kerr & Co., for one 1,200-H.P. triple-expansion engine for the Corporation of Dundee; one from Messrs. Player & Co., Clydach, for one of their standard compound engines for direct coupling to a dynamo of Messrs. Jackson's make for supplying power and lighting to their shops; and one from the Guildford Electric Light Company for a 240-H.P. compound engine for direct coupling to a Newton dynamo.

ELECTRIC LIGHT AND POWER NOTES.

Abersychan.—The D.C. have discussed the matter of the supply of electric light by the South Wales Electrical Power Distribution Company, and it is intimated that inquiries have been made with the view of ascertaining whether the Council would be able to purchase in bulk of the Electric Power Distribution Company, and sell by retail without a provisional order. The result is that it is found that the Council cannot do so, and after a long discussion, it was decided to defer the matter for the present.

Bridgend.—Mr. H. Percy Boulnois, M.I.C.E., held a L.G.B. inquiry on Wednesday last week, into an application by the Council for powers to borrow £6,900 for electric lighting purposes. Alderman Hughes stated that a prov. order for electric lighting was obtained in 1893, but the Council had been unable to utilise it until the recent advent into the district of the South Wales Electrical Company, which was supplying the energy on a sliding scale, and by an arrangement with the Asylums Committee the Council would be able to get their supply at 2½d. per unit. The Council intended using the electricity for public lighting, and to supply private residences and business establishments at a charge of 5d. per unit. An estimate of the annual expenditure and income showed a profit to the Council of £225. Mr. H. T. Sully, of Bristol, electrical adviser to the Council, also gave evidence.

Brighton.—The Mayor (Alderman Stafford), on the 18th, switched on for the first time a large electric motor, which will be used for pumping sea water into Brills Baths. In the course

of a few suitable remarks, he stated that this motor was replacing the old steam pumps, and would fill the baths in four hours, whereas it used to take 12 hours, and the cost will now only be one-third, thus effecting a saving of over £700 per year. The Council have decided to hold an electrical exhibition in the Aquarium during the first fortnight in July. Mr. John Christie, the manager of the electricity works, has been appointed hon. secretary.

Bury.—The annual report of the electricity works, presented last week, shows that there are 305 consumers, with 24,668 8-c.p. lamps, an increase of 51 consumers, with 6,109 8-c.p. lamps. The units sold totalled 323,337, against 261,247 last year. The revenue for the year had increased by £857, or 20 per cent., and the generating costs by £57, or 2¼ per cent. The gross profit was £2,450, compared with £1,650 for the previous year. Interest on loans, bank interest, and sinking fund charges had increased from £2,307 to £2,609. The result was a loss of £158 on the year's working, compared with a loss of £657 last year.

Chesterton.—The Cambridge Electric Supply Company, Limited, intends to apply to the B. of T. in December next for an order to supply electricity for public and private purposes in the district of Chesterton and the parishes of Cherryhinton, Coton, Fen Ditton, Girton, Grantchester, Impington, Great Shelford, and Trumpington.

Cleckheaton.—The U.C. has asked the L.G.B. to sanction a further loan of £6,000 for electrical purposes.

Dewsbury.—To commemorate the Coronation, an electric light installation is to be laid down in the General Infirmary, at an estimated cost of £500.

Huddersfield.—Messrs. David Brown & Sons, who require about 100 B.H.P. for their new works, having inquired at what price the Committee could supply the energy, it was resolved that if the consumption exceeds 25 units per hour for 2,400 hours per annum, the charge be ·975d. per unit; 50 ditto, ·95d. per unit; 75 ditto, ·925d. per unit; and 100 ditto, ·90d. per unit. One hundred meters have been ordered from the British Westinghouse Company. The L.G.B. having declined to sanction the borrowing of money for the costs of obtaining the Electric Lighting Orders of 1890 and 1896, viz., £516 12s. 8d., the sum has been charged to the depreciation and contingencies account.

King's Lynn.—The third annual balance-sheet of the Corporation electricity works for the year ended March 31st, 1902, shows that the total revenue for the year amounted to £4,347 2s. 9d., and the total expenditure (excluding capital charges) to £2,711 2s. 1d. Interest, and instalments of principal, amounting to £2,429 6s. 3d., were paid during the year, giving a net deficit on the year's working of £793 5s. 7d. The revenue from private lighting amounted to £1,837 8s. 5d., and from public lighting £1,911 18s. 4d. Rental of meters produced £99 2s. 5d., and sale and repairs of lamps £498 12s. 7d.; 12,010 8-c.p. lamps (an average of 35 lamps per consumer), and 12 motors, were supplied with 93,274 units, at an average price of 4·73d. per unit; and public lamps, consisting of 442 pairs of 16 c.p., 10 pairs of 25 c.p. and 22 arcs were supplied with 193,405 units, at an average cost of 2·57d. per unit. The cost of generation was as follows:—Works cost 1·26d., total cost 1·74d. per unit generated. The maximum supply demanded was 210 KW.

London.—ISLINGTON.—The M.B.C.'s electrical engineer, Mr. A. Gay, presented his annual report last Friday. There had been a deficit of £1,027 on the previous period of 15 months, but for the year ending March 31st last the net profit was £1,402, in spite of the fact that capital charges had increased by £1,251, and that the total of units supplied was 138,000 less. The chief points in the detailed accounts were: Capital expended from 1895 to date, £365,842 (of which in round figures, buildings and site accounted for £95,000; boilers and machinery, £98,000; mains, £128,000; lamps and columns, £14,000; and transformers and motors, £15,000; the total additional capital expended during the year being £43,500). The revenue was £41,308; working cost, £24,639; generation, £17,198; distribution, £880; public lamps, £2,016; rates and taxes, £1,431; establishment charges, £3,073; sundries, £40; gross profit, £16,668; interest, £10,769; capital repaid, £4,510. The units sold were: Public lamps (933,449 at 3½d.), £13,612 15s. 11d.; private (503,000 at 7d., 725,441 at 4d., and 24,154 at 2d.), £26,962 16s.; meter rents, &c., £732 16s. 4d.; total working cost per unit, 2·71d.; average revenue per unit, 4·45d.; number of public lamps, 400. The total net losses since 1895 are £6,604, compared with total net profits, £6,079, made in the years 1898, 1899, 1900 and 1901. The chief feature of last year's business was the increase in energy sold to private consumers, which was formerly nearly equal to the public supply. The demand is still increasing, and it is contemplated to reduce the price of energy for next winter.

Ormskirk.—The Board of Guardians have offered to become consumers if the Urban Council adopts an electric lighting scheme.

Portsmouth.—The T.C. has resolved to purchase 310 meters from the Newcastle-on-Tyne Electric Supply Co. at a cost of £600.

Rhyl.—The Council has accepted the tender of Messrs. Firth & Sons, Manchester, for wiring the Town Hall, 16 firms tendering. 3d. per unit is figured as a quotation for the arcade lighting scheme by the Electric Light Committee, provided a guarantee is given for the use of 20,000 units within 12 months, the arrangement to be for one year.

Rawmarsh.—The U.D.C. will apply to the B. of T. for an extension of its electric lighting order, which should expire at the end of July, 1902.

Sheffield.—An error occurred last week in our note on the Corporation electricity accounts. We stated that the net profits of the Department were £5,604, as compared with £6,294 for the previous 12 months. The latter item, however should read £4,048, and not £6,294. Mr. S. E. Fedden is to be congratulated on such satisfactory progress.

Sleaford.—The Council has resolved to buy an electric motor (£267) for working a pump in connection with the new sewage farm.

Spain.—A Barcelona firm has just completed a central electric lighting station in the town of Berga. Water-power is utilised, the plant comprising two 175-H.P. turbines connected by ropes to two eight-pole dynamos. As a reserve, a multitubular boiler and a Westinghouse engine of 150 H.P. have been laid down.

Stretford.—The L.G.B. has sanctioned the borrowing of the sum of £54,000 by the U.D.C. for electricity works. The generating station will be commenced immediately, and the Council, it is expected, will be in a position to supply the public with electricity in about six months' time.

Swansea.—The annual report of Mr. C. A. L. Prusmann, borough electrical engineer to the Electricity Committee, shows that the capital outlay now amounts to £60,230 15s. 9d. The revenue was £4,571 12s. 3d., and the total cost of production £2,308 8s. 2d., giving a gross profit of £2,263 4s. 1d. After paying interest and a sum held over from last year there remains a deficit of £349 9s. 10d., in addition to the sinking fund instalment. The maximum load was 423 KW., and the total output 319,215 units.

Tiverton.—The T.C. has informed the B. of T. (who asked what steps the Corporation proposed to take to retain its order now that the water power electric lighting scheme had been abandoned) that a gas works scheme is contemplated.

ELECTRIC TRACTION NOTES.

Bilston.—The Bilston tramway is now practically completed, and last week a trial trip took place, a car being run from the Dudley and Sedgley line at the Fighting Cocks to the Town Hall, Bilston, from there to Moxley, thence along the Wellington Road, and back to Dudley. The result of the trial was most satisfactory. The power for working the cars is supplied from a transforming sub-station of the Midland Electric Corporation for Power Distribution, Limited, which has been erected at Mount Pleasant, Bilston. All the electric current is generated at that company's main generating station at Ocker Hill, and is transmitted to sub-stations at Bilston, Wednesbury, Brierley Hill, Old Hill, and Tipton. Through the Bilston sub-station electric light and power will be supplied for public use at Bilston and Willenhall. The electricity reaches Bilston from Ocker Hill at a pressure of 7,000 volts, is transformed, measured and controlled, and after passing through safety devices, is taken over by the British Electric Traction Company's switchboards, where it is again measured, and passes out to the lines. The plant was supplied by the Westinghouse Company, and the whole of the work has been carried out under the direction of Messrs. Kincaid, Waller and Manville. Other contractors were Kelvin & James White, Limited, and Messrs. Ferranti. It is worth mentioning that everything, with one exception, is British made, and the same can be said of the generating station, where the only machinery in use of foreign manufacture is the coal unloading and conveying plant, which was supplied from America. The British Insulated Wire Company are responsible for the whole of the cables.

Bingley.—The Urban Council last week adopted a scheme prepared by Mr. Quin, electrical engineer, Blackpool, for a continuous tramway route from Bradford to Keighley. On behalf of a syndicate Mr. Quin agrees to equip the line, taking the power for running from the Council, which is to receive £500 a year for 30 years, and the cost of a provisional order. The syndicate further agrees to pay £3,000 towards the cost of constructing a new road along the route.

Brighton.—On the 14th inst. the service of 'buses between Brighton and Preston was discontinued, owing to the competition with the electric cars. That there are very considerable extensions contemplated is evident from various remarks which have been made in the Council lately, although at present no definite proposals have been brought forward. The Tramways Committee requested the Council to sanction a deputation to Norwich to see how the difficulty of running cars through narrow streets had been overcome in that town, but the proposal was rejected by a large majority. The average number of passengers carried per week now is about 180,000, and the receipts between £750 and £800.

Chatham and District.—In last week's report of the opening ceremony several slight errors were made. In line 10 for "Janate" read "Jarrah"; in line 35 read the smaller "engine" *not* "engines." Mr. C. H. Merz, we learn, has only just been

appointed consulting engineer to the Chatham and District Light Railway Company, *not* the British Thomson-Houston Company; line 56 should read "with whom is associated Mr. A. H. Walton, as the engineer to the British Thomson-Houston Company," who was responsible for the design of the whole system.

Heaton Norris.—The Heaton Norris District Council has decided to take up a loan of £7,000 for tramway purposes, to be repaid in 21 years at £3 12s. 6d. per cent.

Huddersfield.—The B.C. has empowered the Tramways Committee to order 10 additional cars from the British Electric Car Company. The earnings (receipts only) of the tramways for April (electric sections) were £3,283 7s. 4d., an increase of £558 15s. 3d. upon the corresponding month last year. The receipts on the remaining steam sections were £796 3s. 3d., a decrease of £534 4s. 5d., or a net increase of £24 10s. 10d., or 10·82d. per mile.

London.—The proposals of the Highways Committee to construct over 33 miles of new tramways at an estimated cost of £1,738,857 will also be considered. There will be 11½ miles of lines on the north of the Thames, which are estimated to cost, with the cars and car sheds, £529,850, and for street widenings £64,416. On the south side the mileage of new lines amounts to 22, and the cost of construction and plant is estimated at £945,700, and street widenings at £198,891. The Committee propose that the new lines which will be ultimately connected with the North Tramways Company's lines, leased until 1910, shall be constructed for horse traction, unless before the time arrives for their construction, effect shall have been given to the provisions in the company's lease relating to the reconstruction for electric traction of the leased tramways or the parts of them immediately adjacent to, and to be worked in connection with, the new tramways. Those of the new lines which will be ultimately connected with the London County Council tramways, or which, being at first detached from either of the Council's tramway undertakings, could be worked independently, they propose shall be constructed for electric traction.

Middlesex.—At the last meeting of the M.C.C. the Light Railways Committee recommended that loans to the amount of £779,312 be borrowed for carrying out the first portion of the scheme for light railways in the county of Middlesex.

Oldham.—The general manager has been instructed to obtain particulars of snow ploughs for the tram lines.

Richmond—Hampton.—The first trial trips of electrical cars on this line were made on Friday on the section between Busch Corner, Isleworth, and the end of Cole Park Road, Twickenham. It is expected that the line will be open for passengers next week. At Hampton, the water mains under the L.U.T. track have been lowered.

Yarmouth.—The new electric tram system started running on 20th inst.

TELEGRAPH AND TELEPHONE NOTES.

Canadian Cables.—Arrangements are being made by the Dominion Minister of Public Works for the laying of a cable between Anticosti and the Magdalen Is., a distance of about 116 miles.

Reduction of Telegraph Rates.—The Western Telegraph Company announce the following reductions in tariffs from July 1st next:—Lagos, from 6s. 5d. to 6s. 3d. per word; Brass, 6s. 7d. to 6s. 3d.; Bonny, 6s. 10d. to 6s. 3d.; Lagos Government stations, 6s. 7d. to 6s. 5d.; Cameroons, 7s. to 6s. 5d.

Wireless Telegraphy.—A Berlin despatch to the *Standard* says that according to a telegram from Korea to the *Kölnische Zeitung*, the Korean Government has declined to grant a concession to Japan for the establishment of wireless telegraph stations along the Korean coasts, as it intends itself to establish such a service.

It is stated that the United States Navy Department has ordered all ships undergoing repairs to be fitted with wireless telegraphy apparatus.

CONTRACTS OPEN AND CLOSED.

OPEN.

Austro-Hungary.—Sept. 1st. The municipal authorities of Klausenburg (Kolczsvar), Siebenbürgen, are inviting tenders until September 1st, for the establishment in the town of a central station for electric lighting and power purposes. Tenders are to be sent to Bela Fekete Nagz. Kolczsvar, from whom particulars may be obtained. See "Official Notices" May 9th.

Chili.—The Chilian Government proposes to construct a cable connecting Punta-Arenas and Puerto-Montt. Particulars concerning the proposed undertaking can be had by those interested from the Chilian legations in the various capitals.

Devon.—July 23rd. Wiring work at Devon County Asylum, 2,000 lamps, booster dynamo and motors, switchboard, and replating battery. See "Official Notices" to-day.

Epsom.—July 18th. Semi-marine dry-back boiler, condensers, pumps, cooling pond, piping, one 150-KW. steam dynamo, switchgear, &c., for electricity works extensions. See "Official Notices" June 20th.

Falkirk.—July 14th. Pumps, balancing transformers and motor-generators, storage batteries, switchboard, arc and incandescent lamps, cable work, and travelling crane. See "Official Notices" June 20th.

Gillingham.—July 17th. Water-tube boilers, piping, condenser, cooling tower, high-speed engines, and 250-KW. three-phase alternators, switchboard, cables, arc lamps, crane and well, for the U.D.C. See "Official Notices" June 20th.

Ipswich.—July 5th. Engines and dynamos, storage battery, overhead hand travelling crane, feeders, mains, &c., permanent way construction, and arc lamps. See "Official Notices" June 6th.

Launceston (TASMANIA).—September 15th. The Corporation wants tenders for polyphase generating, transmitting, transforming and distributing apparatus, reconstructing existing plant, enclosed arc lamps, &c. See "Official Notices" May 23rd.

L.C.C.—July 15th. 80 double-deck cars with trucks, motors, ploughs, &c. See "Official Notices" to-day.

London, S.W.—July 31st. The War Office wants tenders for a self-propelled lorry (oil). See "Official Notices" April 25th.

Manchester.—July 1st. The Electricity Committee invites tenders for stores, including incandescent lamps, &c.

Manchester.—July 3rd. The Electricity Committee invites tenders for the supply, delivery, and erection, at their Dickinson Street generating station of high and low-pressure piping for two 1,800-KW. turbo-generators.

Manchester.—The Corporation are advertising for tenders for electricity sub-stations at Chorlton-cum-Hardy and Whalley Range.

Norway.—July 7th. The Board of Trade notify that tenders will be received at the Norwegian State Telegraph Department not later than noon on July 7th, for the supply of 256 pair and 204 pair telephone cable, and for Leclanché battery glass. Specifications and conditions can be seen in the Technical Department of the Board of Telegraphs, Christiania.

Nuneaton and Chilvers Coton.—July 2nd. Cables, joint boxes and compounds; also arc and incandescent lamps, columns, switches, &c., for the U.D.C. See "Official Notices" June 20th.

Queensland.—July 28th. Tenders will be received at the office of the Deputy Postmaster-General, Brisbane, till July 28th, for the supply of telephone cable and switchboards as follows:—(1) Two miles 104 pair cable to specification No. 6; (2) Five miles 52 pair cable to specification No. 6; (3) Two miles 39 pair cable to specification No. 6; (4) Two miles 26 pair cable to specification No. 6; (5) One mile 13 pair cable to specification No. 6; (6) Two miles 26 conductor to specification No. 7; (7) Five metallic circuit telephone switchboards (100 lines) to specification No. 8. Specifications can *only* be seen, and forms of tender obtained, at the General Post Offices, Sydney, Melbourne, Brisbane, Adelaide, Perth and Hobart.

Romford.—June 30th. The U.D.C. wants offers for the construction and maintenance of electricity supply works. See "Official Notices" June 13th.

Servia.—July 1st. Tenders are being invited until July 1st by the Société d'Electricité de Leskovatz (Servia) for the supply and erection of two 200-H.P. turbines, two three-phase alternating dynamos of similar capacity, and the necessary accessories for the transmission of the power generated to Leskovatz, a distance of 10½ miles. Tenders are to be sent to Le Conseil d'Administration de la Société d'Electricité, Leskovatz, Servia, whence particulars may be obtained.

Spain.—June 30th. Tenders are being invited until the 30th inst. by the Spanish Ministry of Agriculture, Industry and Commerce, for the supply of the necessary apparatus required at the station for testing and verifying electricity meters about to be established.

Stalybridge.—July 7th. Three 500-KW. steam-driven three-phase alternators; three 50-KW. continuous current exciters; permanent way, bonding and cable conduits for the Stalybridge, Hyde, Mossley, and Dukinfield Tramways and Electricity Board. See "Official Notices" June 13th.

Sunderland.—July 10th. Permanent way, overhead equipment and cables for the Corporation tramways department. See "Official Notices" June 13th.

Sydney.—July 23rd. Complete system of high and low pressure cables, and of arc lamps for street lighting, for the Municipal Council. See "Official Notices" June 13th.

Valparaiso.—September 1st. Construction and equipment of electric tramways. Further particulars from the Chilian Consulate.

Willington Quay.—July 4th. The Willington Quay and Howdon Industrial Society, Limited, invite tenders for electrical apparatus for power and light at their Bewick Road premises. Specifications and plans, with schedule of quantities, can be had on payment of a fee of 5s. Tenders to be lodged by Friday, July 4th, with the chairman of the Committee.

CLOSED.

Brighton.—The Tramways Committee have accepted the tender of Messrs. Bolckow, Vaughan & Co., Limited, of Middlesborough, for the supply of 300 tons of steel girder tram rails, 12 tons of fish-plates and 20 tons of steel sleepers for £2,611 10s. The tender of Messrs. Askham Bros. & Wilson, of Sheffield, has been accepted for the supply of points, crossings, drain boxes, sole plates, tie bars, bolts and nuts and other sundries for the sum of £1,117 19s. 11d.

Cleckheaton.—The U.D.C. has placed an order for five electric motors for the electric lighting station with the Lancashire Dynamo and Motor Company, Limited, of Trafford Park.

Hackney.—The Borough Council on 12th inst. accepted the following tenders for the extensions of the municipal electricity works:—Section R—Boiler house plant, three water-tube boilers, feed pump, steam and water pipes, &c., Messrs. Babcock and Wilcox, Ltd., £6,910 5s. 0d.; Section S—Water softening plant, capable of softening 10,000 gallons of water per hour, Messrs. Babcock & Wilcox, Ltd., £1,120.

Huddersfield.—The B.C. last week instructed the Electricity Committee to purchase 1,000 yds. of ·1 cable and 1,000 yds. of ·048 cable from the Callender Cable Company, Limited. A hundred meters were ordered from the British Westinghouse Company.

Metropolitan and District Railway.—We are informed that after severe competition, the British Thomson-Houston Company, Limited, of Rugby, have recently closed a contract with the Metropolitan and District Railway for the switchboard to control the 10 5,000-kw. and 11,000 volts generators and other electrical auxiliaries in their generating station. It will consist of 47 black-enamelled slate panels divided as follows:—Four generator exciter panels; One exciter feeder panel; Two rotary converter panels; One direct current generator panel; One storage battery panel; Two direct current feeder panels; One low-tension transformer panel; Three induction motor panels; 12 feeder panels; 10 generator instrument panels; 10 generator controlling panels. All generator and feeder circuits are to be controlled by British Thomson-Houston high-tension oil switches, type H, mounted in fire-proof brick compartments, which are capable of opening a dead short circuit of the entire station, and which are to act as automatic circuit-breakers in the feeder circuit; they will also be capable of opening the circuit in case of reversal of current, thus forming an automatic circuit breaker without the interposition of high-tension fuses, a most reliable arrangement.

Liverpool.—The Liverpool Overhead Railway Company have placed with the St. Helens Cable Company, Limited, an order for eight miles of 37/14 dialite bitumen cable.

Newcastle.—The Rochdale Electric Company, Limited, have just received an order for 1,000 slot meters from the Northern Counties Electric Supply Company, Limited, Newcastle. This is probably the largest order for an Electric Prepayment Meter ever placed, and thus makes a record in the trade. The order is all the more significant as it follows upon one for 500 meters given to the same firm by the Northern Counties Electric Supply Company this year.

Russia.—La Société des Tramways et Eclairage Electriques de Vladicaucas has placed the contract for the whole of the plant required for the electric tramways to be constructed in the town of Vladicaucas (South Russia) with the Helios Company of Ehrenfeld, Cologne, Germany.

FORTHCOMING EVENTS.

Thursday, July 3rd.—At 8.30 p.m. Röntgen Society. Annual general meeting at 20, Hanover Square. Election of officers for the ensuing year.

NOTES.

God Save the King.—At the moment of going to press with the last of these pages, the news of the serious illness of His Majesty the King is announced. The cessation of everything in the nature of preparations for Coronation ceremonials and rejoicings will cause widespread disappointment—in fact, that alone is a disaster—but these are paltry matters compared with the anxiety which the grave news has caused in every truly British heart. All that the anxious millions can do is to hope and pray fervently for the speedy recovery of His Majesty King Edward VII. It seems that a surgical operation for perityphlitis was successfully performed on Tuesday.

An Aluminium-Sheathed Cable.—Hidden away from cable engineers in our contemporary, the *Electrochemist and Metallurgist*, appears an article on the above by Mr. C. Bright, F.R.S.E., devised "by him some time back," and it seems, therefore, a pity that he has not had leisure to revise the design since then. The cable proposed is evidently intended for a deep-sea type, as the reduction in weight of the armouring claimed renders it unsuitable for any other purpose; this armouring or sheathing is to consist of a thin metallic riband "about a ¼-in. broad with a spiral turn completed in 6 in. . . . in the case of a cable or rope not exceeding 2 in. in diameter, increasing, of course, with larger cables," and the "novelty of this device" is that the thin metallic ribands are to have a small space between their edges for pliability's sake. A deep-sea cable is not more than 1 in. in diameter, and with such an aluminium sheathing, we wonder how much of this cable would reach the sea bed before the edges of the strip were in contact, and the conductor qualifying for wireless telegraphy. "Aluminium is only equalled by copper as regards pliability," and therefore it—"or any alloy"—is admirably suited "for the sheathing of a submarine cable;" this is stated to be "readily understood," but as many alloys of aluminium are as brittle as glass, a little explanation of the author's "understanding" in this deduction would seem necessary. The failure of aluminium in salt water is obviated by the "snakes in Iceland" process; there is no air at the deep-sea depths to cause oxidation, but then in this case any other material will do as well. We would also draw attention to the fact that it is not the weight of a deep-sea cable, but its bulk that decides the maximum length which a ship can carry. The difficulty of joining aluminium is passed over in the usual way by reference to "vast improvements," but the fact still remains that aluminium may be smearable, but is not solderable. We do not for one moment fear that any engineer would be affected by the author's mixture of physical qualities, but if the article is introduced for the purpose of extending the supposed applicability of aluminium to such a purpose, and bringing it to the notice of the unwary, then we hope that this reference to the article, which otherwise hardly merits mention, will not be in vain.

Machinery Users' Association.—The annual general meeting of this Association was held on Thursday, the 19th inst., at the Westminster Palace Hotel. Sir W. H. Houldsworth, Bart., M.P., presided, and amongst those present were Mr. W. H. Holland, M.P., Mr. George White, M.P., Mr. W. E. M. Tomlinson, M.P., Mr. Lewis Evans, J.P. (treasurer), Major Vane Stow, and others. Sir William Houldsworth, in moving the adoption of the report and accounts, referred to the improved position in which the Association stood, owing to the report of the Royal Commission on Local Taxation, and to the recent judgment of the Lord Chief Justice in the case of Crockett and Jones and the Northampton Union Assessment Committee. A recent decision in Scotland, adverse to the manufacturers, has brought a great amount of Scotch support to the Association. Mr. Lewis Evans referred to the question of water supplies as being a most important one for manufacturers, and Mr. W. H. Holland, M.P., spoke with approval of the formation of the Commercial Committee in Parliament.

Treatment of Boilers Under Forced Draught.—An excellent paper on the treatment of boilers under forced draught is published in the *Proceedings of the Institute of Marine Engineers*. The paper is by Mr. Rule, who had charge some years ago of a forced draught steamer of 3,333 tons. She was exact sister ship to another vessel except for the boilers, which were two in number in each ship, double ended in the ordinary ship, and only single ended in the forced-draught ship, which had, in fact, just half the grate surface of the other ship, yet had the same sea speed, used the same coal, and was thus expected to burn twice the coal per unit area of grate. The fan employed was 6 ft. in diameter, driven by an 8-in. cotton belt, the fan engine being where it should be, in the engine room. The air was drawn through heating tubes above the boiler smoke boxes. The tubes were 2 in. diameter, had spiral retarders, or, as they ought to be called, rotaters. Air was blown under the grates as well as above the bars, and the furnace and ash-pit doors were jointed with asbestos. The system was Howdens, and the air pressure was from ½ to 1¾ above the fire, and ¾ to 2 below the bars. A pressure of 2 in. was never allowed to be exceeded even for the Indian coal, which was very inferior. The air temperature never exceeded 1200°, and was usually 100° at the fan intake, whence it passed forward through the heaters. During the 18 months that Mr. Rule was on the ship, there were no repairs needed, no

buckled combustion plates, no furnace crowns down, and no leaking tubes. At times the grate bars showed signs of distress, which perhaps was not surprising. No salt water was used for make up, nor were the boilers even started with salt water; salt only got in by condenser leaks or evaporator priming, and it never reached 5 oz. per gallon. Feed was usually put in at 210°, and when getting up steam a pump was kept at work drawing water from the bottom of the boiler, and pumping it back at the water line until at least 60 lbs. was reached, a method which certainly keeps boilers at uniform temperature and prevents straining. Zinc tiles were studded inside the boilers to the weight of 11 lbs. per square foot of grate. Only rolled zinc was used. Old zinc was cast into blocks and laid on the boiler bottom, and the steam space was painted with zinc white in kerosine. No oil was used in the engines except to swab piston rods. Except for fire bars all expenses were about halved as compared with the sister ship. For the total voyage the consumption was from 1·8 to 2·3 lbs. of Bengal coal per I.H.P.-hour. On one voyage of 14,000 miles, the ship burned 500 tons of coal less than the sister vessel, and made ½ knot greater speed. The comfort was far greater, or rather the discomfort was far less in the tropics, and only those who have been to sea know what a tropical stokehold may mean. Mr. Rule finds that the ship is entirely free of atmospheric conditions. He advocates air heating, and direct driving of the fan, but the fan to be on the other side of the bulkhead from the engine, which, if in the engine room out of the dust, can be properly looked after. Forced draught is making rapid progress at sea, where the highest funnel yet put in, is but a short chimney. There are equally cogent reasons for applying forced draught to land boilers, but engineers are timid, and cannot break off from the chimney idea. There are advantages with the Howden system for land boilers. Air cannot leak inwards, but air and other gases can leak outwards where there is a plenum draught, and this may be inconvenient, though, of course, it compels attention to faulty brickwork. But land boilers can be fitted with induced draught by fans if the above system is not liked, and there is ample evidence of the general benefit to be secured. It must be nearly, or quite, 30 years since fan draught was put in at the mill of Sir H. Edwards, near Halifax. The system worked unnoticed for years, and for anything we know, is still at work. The tall chimney is a quite out-of-date expenditure of capital. Boilers need not make smoke if properly arranged, so that the tall chimney to dissipate smoke is no longer necessary if smoke is not made.

American Society of Mechanical Engineers.—The forty-fifth meeting of this society was held at Boston on May 27th to 30th, and a number of interesting papers were presented. The regulations controlling the reading and discussion of papers are so admirable that we reproduce them in full below, with a strong recommendation to the notice of the organisers of engineering conventions. The need for such is patent to all who remember the fiascoes at the great convention at Glasgow last year:—

1. All papers to claim presentation at any convention must be in type three weeks in advance of meeting.
2. When the secretary sends notice of the meeting, he shall also send a blank by which the members may notify him of their intention to be present at it.
3. Copies of all the papers to be read shall be sent to every member *so signifying his intention to attend.* A blank shall accompany this packet of papers, by which the members may signify their intention to discuss any of the papers, and priority in debate shall be given in the order of the receipt of such notifications.
4. At the convention papers shall be read by abstract only, not more than *ten* minutes being allowed to the presentation. It is assumed that everyone has made himself familiar with the papers beforehand.
5. Members who have given notice of their intention to discuss any papers, and shall have reduced their remarks to writing, shall be entitled to 10 minutes for their presentation; extemporaneous discussion from one person is limited to five minutes at any one time.
6. A member who has once had the floor cannot claim it again until all the others have been heard who desire to speak on that paper.
7. Members unable to attend a meeting may send discussion in writing of any paper, such discussion to be presented under the previous rules.
8. Authors may have the last five minutes of the time allotted for a paper and discussion to close the debate.
9. The time available for papers at every meeting shall be so allotted to the several papers as to secure a favourable presentation of them all. At the expiration of the allotted time the debate on any paper shall be closed and the next paper shall be taken up. Any curtailed discussion may be resumed in order, if time is available after presentation of the last paper on the docket.
10. These rules may be suspended in any session by unanimous consent. Their whole object and tenor is to favour well considered discussion by giving all available time for it, and a chance for every paper.

Nernst Lamp.—A financial paper quotes a Berlin telegram to the *Frankfort Gazette* announcing that the Allgemeine Elektricitäts Gesellschaft has concluded an agreement with the Nernst Electric Light Co., Ltd., of London, whereby the latter agrees to abandon for a series of years the manufacture of the Nernst lamp. The London company has also consented to procure from the Berlin company all the lamps required by it for the purpose of meeting the entire demand for Nernst lamps in those countries which were reserved to it some time ago.

Cardiff Electric Tramways.—In our description of the Cardiff Electric Tramways, we omitted to state that the steel taper poles were made by Messrs. James Russell & Sons, Limited, of Wednesbury.

The Galileo Ferraris Award.—We have received from the offices of the Italian Chamber of Commerce in London (4, St. Mary Axe, E.C.), a notice stating that the committee for the "Galileo Ferraris Award," which was instituted in 1898, being composed of the Representatives of the Executive Committee for the General Italian Exhibition held in Turin in 1898, of the Chamber of Arts and Commerce, of the R. Academy of Science and of the R. Industrial Museum in Turin, have determined to open an international competition for the award of the said prize on the occasion of the unveiling of the monument to that illustrious scientist in Turin in the latter half of the month of September next. The award is of 15,000 Italian lires (£600) together with the compound interest thereof accumulated since the year 1899 up to the day of the award, and it shall be granted to the inventor of some practical application of electricity, from which some noteworthy progress may arise. Competitors may produce either pamphlets, schemes and drawings, or machines, apparatus and contrivances concerning their invention. The jury, composed of the aforesaid committee, shall have full power to cause practical experiments to be made upon the inventions entered for competition, and upon the relative apparatus, contrivances and machines. Competitors are to file their application and deliver their works, machines, apparatus and whatever appertains to their invention, not later than 6 o'clock p.m. on September 15th, 1802, at the office of the secretary of the committee, care of the Administrative Committee of First International Exhibition of Modern Decorative Art in the buildings of the Chamber of Commerce and Art, 28, Via Ospedale, Turin, Italy.

Advertising Electricity.—Are we back to the days when Members of Parliament handled gas pipes with gloved hands? Such would appear from the scare postcard being circulated by an electricity department in the Midlands with reference to Coronation illuminations in which "coronators" are cautioned against illuminating without first notifying the department, lest the mains, meter, &c., be too small for the extra demands. "The result of this will be that not only is there a risk of damaging our apparatus and putting you in darkness, but the danger of setting your premises on fire, *for all of which you will be held responsible.*" The italics are ours. If this does not effectively frighten off customers and introduce gas as an illuminant, what will?

Electric Treatment of Lead Poisoning.—On June 20th the Duchess of Sutherland formally opened at the North Staffordshire Infirmary a new department, consisting of electric baths and other apparatus for the treatment of cases of lead poisoning and paralysis.

Personal.—Mr. Lionel E. Harvey, the superintendent of overhead construction to the Halifax Corporation Tramways, has been presented with a handsome spirit tantalus by the staff of the electricity works on the occasion of his marriage with Miss Crush, of Isleworth.

Mr. Alfred Apps wishes to thank his friends for their kind inquiries; he is now better, after a narrow escape from death by a gas explosion in his workshop basement in the Strand about 10 days ago.

Appointments Vacant.—Assistant to the superintendent of mains at Edinburgh at £150; electrical engineer and tramways manager, at £250, for Swindon; electrical distribution engineer for the L.C.C. tramways department at £350 per annum.

THE CENTRAL STATION ENGINEER.

Mr. G. H. Barnby Holmes, pupil of the city electrical engineer at York, has been appointed to the position of junior assistant engineer, at a commencing salary of £78 per annum. Mr. F. B. Walker, of the Bradford Corporation electricity department, has been appointed chief clerk in the York Corporation lighting department, at a commencing salary of £120 per annum.

ELECTRICITY IN AGRICULTURE.

This question was discussed in a paper read before the recent Conference of the Association of German Electrical Engineers by Dr. R. Haas, of Hanover, who referred specially to the experience gained in connection with the electric tramway in operation in that town. It appears that 48 villages are connected to the distributing network of the Hanover tramways, and 35 of these, with a population of 37,500 persons, have no system of gas lighting at their disposal, and the results obtained from the localities form the basis of the paper. At the end of 1899 motors of a total of 440 H.P. were connected to the mains, and at the close of 1900 these had increased to 1,251 H.P., whilst at the termination of 1901 a further advance to 2,049 H.P. had been

made. The greatest demand for current was manifested for the operation of thrashing machinery, although energy was also used for such purposes as the driving of pumps, hay presses, straw cutters, &c. Of the total horse-power installed, 77 per cent. represented pure agricultural operations and 8 per cent. factories, although the former only yielded 53 per cent. of the receipts. On an average the annual revenue per horse-power installed amounted to 27s. 8d. (as compared with from £3 10s. to £7 10s. in towns) at a price of 2·4d. per kilowatt-hour, and the average period of use did not reach 150 hours, as against 500 hours in towns. As far as illumination is concerned, the author remarked that the electric light in agriculture is not, from an economic point of view, of the same importance as the electric motor. The lamps are installed in fair numbers, but they are not used. The demand for light in the villages is not great, as the people retire early and rise early, and night life does not exist. It happens that, in the case of installations of 30 lamps in one house only a single 5-c.p. lamp is regularly used. In towns the revenue per lamp installed amounts to about 14s. per annum with a lighting period of 450 hours, whereas in the 35 villages the average sum realised only reached 6s. 6d. per lamp installed and a consumption extending to 260 hours.

The author concludes from the experience in the Hanover district that satisfactory results would only be possible in agricultural operations where cables already exist for the transmission of power or the operation of electric tramways, and which could readily satisfy the small and occasional demand for agricultural purposes.

NEW COMPANIES REGISTERED.

Farrall Incandescent Electric Light Syndicate, Limited (74,081).—This company was registered on June 17th, with a capital of £10,000 in £1 shares, to adopt an agreement with T. D. Farrall, and to carry on the business of electricians, engineers, producers and suppliers of electric power and light, manufacturers, contractors, builders, importers, exporters, merchants, manufacturers of electrical apparatus, &c. The first subscribers are:—E. C. Macmillan, 44, Rock Lane West, Rock Ferry, Ches., gentleman, with 550 shares; C. F. Lewns, 30, Chatsworth Road, Brondesbury, N.W., stockbroker, with 100 shares; N. B. Falconer, Swan Chambers, Copthall Avenue, E.C., gentleman, with 100 shares; J. B. Gemmell, 47, Burton Crescent, W.C., gentleman, with 100 shares; T. D. Farrall, 8, Glenloch Road, Hampstead, N.W., electrical engineer, with 750 shares; F. G. Soper, 8, Priory Avenue, Hornsey, N., gentleman, with 100 shares; and T. D. Farrall, jun., 8, Glenlock Road, N.W., electrical engineer, with 100 shares. Minimum cash subscription 50 per cent. of the shares first offered to the public. Table "A" mainly applies. Registered office, 22, Chancery Lane, W.C.

English and General Tramways Co., Ltd. (74,105).—This company was registered on June 19th, with a capital of £5,500 in 5,000 ordinary shares of £1 each and 10,000 deferred shares of 1s. each, to acquire, construct, or be interested in any tramways or railways, and to equip, maintain and work the same by electricity, steam, horse-power or otherwise. The first subscribers (each with one share) are:—J. D. Baucus, 5, Warwick Court, High Holborn, W.C., merchant; T. E. H. Hodgson, St. Mary's Abbey, Bedford, gentleman; P. J. Brenchley, 5, Mortlake Road, Ilford, clerk; W. J. Smith, 45, Clipstone Street, Portland Place, W., clerk; F. B. Sweeting, 33, Shireff Road, W. Hampstead, clerk; A. T. Salisbury-Jones, 18, Austin Friars, E.C., stockbroker; and C. C. Sercombe, 18, Austin Friars, E.C., stockbroker. No initial public issue. The subscribers are to appoint the first directors. P. J. Brenchley is the first secretary.

CITY NOTES.

W. T. Henley's Telegraph Works Company, Limited.

MR. SYDNEY GEDGE, chairman, presided last Friday at the ordinary general meeting of the shareholders of this company, held at Cannon Street Hotel. In moving the adoption of the report, he said, that with regard to the balance-sheet, there was very little to call their special attention to. The capital remained the same, both ordinary and share capital, viz., £200,000 each, the amount of capital actually subscribed was £175,000 of each class, and the directors might before long have to ask the shareholders to increase the capital to £200,000, because the business of the company and other exigencies of the trade might not improbably render it desirable that they should add to their works. They were all very glad to know, at the same time, that the directors knew the advantage of keeping the capital as low as possible, and the shareholders might rely upon it that no further issue would be made unless the directors saw it was going to earn new profits, or that there would be any difficulty in paying the 20 per cent. dividend. The mortgage debenture stock remained at £50,000. It would be noticed by comparing the moneys owing to the company and the moneys they owed, that, considering the large extent of their business, both were very reasonable. Their debtors paid up their accounts very properly, as likewise did the company pay their debts. The reserve under cable repairing contract continued to increase, amounting to £7,215 6s. 10d., and had not had to be drawn upon during the past year. The net profit for the year 1901 was £57,449 13s. 6d., which was a little more than last year. They brought forward from the previous year's account £24,000, which he thought was very much the same as in the year preceding, and the result was that the directors were able to declare a dividend for the year of 20 per cent., of which the shareholders had already had 15 per cent., leaving 5 per cent. to be paid, and that would be posted to them that evening. There was a paragraph in the report on which the shareholders would be anxious to have some information, and the reasons for the statements which had appeared in the newspapers respecting it. The report stated that negotiations for the amalgamation of the company with Messrs. Callender's Cable and Construction Company were still proceeding. That was true at the time the report was printed, which was on June 10th, but, as many of them were already aware, those negotiations were not now proceeding, but had come to an untimely end. The shareholders had received a circular to this effect. The directors regretted to say that certain difficulties had arisen between that company and the Callender Cable Company as to the terms of the proposed amalgamation, and the negotiations had been treated as at an end. The board had been of opinion, and were still of opinion, that the amalgamation between two such companies was likely to prove to the benefit and advantage of both parties concerned, provided that it could be arranged on proper terms. To amalgamate the two companies it was necessary to form a new company to combine both the old ones, and that each company must be allotted certain interests. They had to be careful that they received their proper proportion in the new company, and to see that what they had to sell had been taken upon a proper basis. As to what was the right basis, the directors had been unable to come to any agreement. The next point which had to be considered was that the arrangements for the new company must be such as to ensure as far as possible the harmonious working without friction of the two concerns thus brought together. He was sorry to say that in that case the directors failed to see eye to eye on certain points, and he thought there was sufficient reason on that ground why the amalgamation should not be proceeded with. The negotiations had been conducted in a most friendly manner, and had ended in the most friendly manner. The door had been shut, but not slammed, for the board had no wish but to keep up the friendly relations between the two companies, and he had no doubt that when the meeting of Callender's Cable Company was held, very much the same tone which he was taking that day would be taken there. He thought neither company had any reason to complain of the other, and he saw no reason why the amalgamation might not be brought about in time to come.

MR. G. SUTTON, managing director, seconded the motion, and said that when the accounts were made up it was contemplated that Callender's Cable Company and Henley's Telegraph would be one company. He wished the shareholders to be assured that the accounts of that company had been made up in exactly the same manner as they had in the preceding year. The stocks, a very important part of the accounts, had been taken upon the same low standard as in previous years; in fact, the standard had been actually lower than the market price. One of the chief items of stock was copper, and during the last year there had been a considerable fall in the copper market, and a large part of the company's stock had to be written down at market price, involving a great loss to the company, but it was, of course, a loss which must necessarily occur in all manufacturing firms at times. The industrial prices in Germany had played havoc with part of the company's business, for the price of cables sold in Germany had been ruinous. Notwithstanding this their balance-sheet showed that their profits had been larger than hitherto. The American competition had also affected their business to some extent, but that had been with regard to prices. A good deal had been said in the public Press with regard to the electrical industry, and as to the backwardness of English manufacturers as compared with Americans. That, however, was not the case in respect to the cable manufacturers of this country, for they had been right in the front, and could manufacture quite as well and as cheaply as any American manufacturer.

The report was unanimously adopted.

Kalgoorlie Electric Power and Lighting Company.

MR. R. W. WALLACE, K.C., chairman, presided at Winchester House, E.C., on Monday afternoon over the third ordinary meeting of the shareholders of the above company, and in moving the adoption of the report, said that it was some time since he had addressed them, but in the meantime they had kept the shareholders fully informed of their movements by circulars and reports of the engineers. The period for which the accounts was made up was 15 months, instead of the usual 12 months, because the directors came to the conclusion that it would be better to have their accounts dating from the first of the year. With regard to the accounts, the capital account spoke for itself. Bills payable, £8,541, and sundry creditors, £2,517, were in respect of contract work. The liability on uncompleted contracts was £61,514, £55,000 of which was on general contract, and £4,256 was for tramway machinery. They had taken over the work of the Kalgoorlie Tramways, and in order to do that work it was necessary to put up some additional plant not included in the original contract. The tramways were now working satisfactorily, and were the company's first customers. With reference to calls unpaid—£36,215—he expected they would require some explanation. He told the shareholders at the last meeting that they were not going to be rigid about the calls, as it was not necessary, considering the amount of liabilities they had to meet in connection with the contract, and consequently taking into consideration the depressed state of the mining market they had not pressed share-

holders to pay those calls. The course they had adopted seemed to have been a very judicious one, for the amount at which the item stood in the balance-sheet was now reduced without any pressure to £13,556. He would point out that it was no advantage to the company to get the calls paid up, because the shareholders who were in arrears did not get their 6 per cent., and the company was able to borrow money at a much cheaper rate. There had, however, been other persons, who had taken up shares, who had disputed the right of the board to make those calls, and those persons had been dealt with in a very different way. As the shareholders knew, legal proceedings were taken against the board on the ground that the prospectus was a misleading one, but the case was decided in the board's favour. They had decided to issue £50,000 worth of debentures, and of that sum £10,000 would be taken by the contractors at par. He wished particularly to impress upon the shareholders the fact that the contractors had been of very considerable benefit to the company. They found owing to the work being carried out at such a distance that it would be better to have contractors whose interests were bound up in the company. He had had great experience with electrical work, and he was extremely satisfied with the way Messrs. White were carrying out their contract. At first he must say he was antagonistic to Messrs. White, for he did not think they had the necessary staff for carrying out the work, but he must say now that they had one of the most efficient staffs for electrical work in the kingdom. They made arrangements with that firm to take up shares after the flotation of the company, so that the contractors' interests were practically those of the company, but at the same time he had looked very closely into their accounts, and knew that Messrs. White had not asked more than fair contractors' profit. In addition to this £10,000 debentures taken up by the contractors, they had issued £5,000 debentures, so there was a balance of £35,000 debentures unissued which shareholders could take up if they cared to. The reason they had decided to issue those debentures, was that they had found they could do a very profitable work outside what the original contract was made for in the way of supplying motors, pumps, and so on to the mines. After all their liabilities were met they would have £17,000 working capital left, so that they had enough capital at present to go on with. He would not promise they would not issue more capital, and he hoped, indeed, that it would become necessary to do so, but that was their present limitation, to see what profits they could make. With regard to the other items in the accounts, they would notice the directors' fees, £2,312, which was for 15 months, but he had suggested to his colleagues that each director should give up £100 of his fees until profits had been earned. There was also an item of special remuneration to directors £125. That was in connection with the action against the company. He might say that he himself attended the Courts constantly, and he was probably not less than £500 out of pocket by having to give up other work. With regard to directors' fees for the local board in Australia, that board had now been dissolved, for they found they could not work properly with two boards, and that it would be better to have a manager to carry out the general instructions of a board in England. There was no profit and balance account, because the contract was not due to be completed until July, 1902, but they had completed a large amount of work, and had been enabled to supply the tramways, which started on May 20th, and those tramways had been running satisfactorily ever since.

Mr. J. P. Doolette seconded the motion.

Replying to questions asked by shareholders, the Chairman said they had only definitely signed one contract at present, which was that with the tramways company, but they could have signed many contracts. They were, however, waiting to pick out the offers most favourable to them. The shareholders need not have the slightest doubt but that all the power they had to offer would be taken up, but they were anxious to pick out those things which would work in with the tramway work. To supply electricity with salt feed water was a very difficult work, but he believed theirs was the best plant that had ever been put in. As to reducing the number of the board, all he could say was that if they found the expense of the directors unfair on the amount earned by the company, he had no doubt the directors would reduce the fees.

The report was adopted.

Lisbon Electrical Tramways, Limited.

The report of the directors for the year ended December 31st last, to be presented at the general meeting to be held in London on the 2nd prox., states that the conversion of the system was continued, with the result that, by the end of the year, more than one-half of the lines were in operation electrically, and there was every prospect of the rapid completion of the whole system as originally provided for. The working of the tramways by animal traction showed a loss, even under the best conditions, and the numerous interruptions, due to the construction, added to it considerably. The first line was opened to the public for electric service on August 31st, and the earnings, which up to the introduction of electric traction had been steadily falling off, immediately increased, and the results of each new service, opened to the public from time to time, have been equally satisfactory. Although the four months under review cannot be taken as an indication of the earning power of the company, the directors feel confidence in stating that, in their judgment, the company can safely look forward to a prosperous career. The accounts show a profit on working of £1,677, and a net debit balance to profit and loss after payment of debenture interest of £28,025.

Thomas Parker, Limited.

The directors' report to be submitted to the eighth annual general meeting to be held at the works, Wednesfield Road, Wolverhampton, on Monday, June 30th, reads as follows:—

Your directors have pleasure in submitting the annexed balance-sheet, which they consider thoroughly satisfactory. After writing off the various depreciations the balance standing to the credit of profit and loss account is £9,049 9s. 9d.; out of this the directors propose to pay a dividend at the rate of 10 per cent. per annum, less income-tax, amounting to £7,060 7s. 2d., and to carry the balance (£1,987 2s. 7d.) forward to next year's account. The director who retires by rotation is Mr. R. Armistead, who is eligible and offers himself for re-election. The auditors, Messrs. Allen Edwards & Smith, also retire, are eligible and offer themselves for re-election.

Greenwood & Batley, Limited.

The report for the year to March 31st last, to be submitted at the meeting on July 5th, states that, after providing for interest on the debentures and expenses of management, and making due provision for doubtful accounts, the accounts show a profit of £31,667, and adding the balance brought forward, £4,474, the total is £36,142. The directors have written off £7,500 for depreciation, and have added £10,000 to the reserve fund, thereby increasing it to £30,000, and they recommend that dividends for the year be declared at the rates of 7 per cent. per annum on the paid-up cumulative preference share capital and of 5 per cent. per annum on the paid-up ordinary share capital, absorbing £15,615, and leaving £3,026 to be carried forward. The buildings, plant and machinery have been maintained in efficient working order and condition, £4,258 having been expended during the year on maintenance account and charged to revenue. Steady progress continues to be made with the De Laval steam turbines for electrical generation, pumping and other purposes. The works of the English De Laval Steam Turbine Company adjoining Albion Works, in which company Greenwood & Batley, Limited, are large shareholders, are completed, the plant is installed and the manufacture of turbines is now being carried on there. The directors look forward to a steady increase in the sales in this important branch of the engineering business.

United River Plate Telephone Company.

The report for the year to March 31st last, to be presented at the meeting on July 1st, states that the gross receipts in sterling for the year in the River Plate were £114,841, as against £109,540 for the year before, and the working expenses in London and the River Plate £60,345. After deducting debenture interest and interim dividends on preference and ordinary shares, and adding transfer fees and interest on investments, there remains a profit of £33,406, to which must be added £6,058 brought forward, leaving £39,465. After transferring £20,000 to reserve fund, which will then amount to £75,000, the directors recommend that a final dividend of 4½ per cent. be paid upon the ordinary share capital, making, with the interim dividend paid, a return of 7 cent. for the year, and that the balance of £6,415 be carried forward.

The Electric and General Investment Company.

The directors' report to be submitted at the meeting to be held at Winchester House, at 1 o'clock p.m., on Thursday, July 3rd, 1902, says that the profit and loss account for the year ended May 31st, 1902, shows a gross profit on the transactions of the year of £32,247 10s. 11d. After deducting all general charges and the interim dividends already paid on the preference and ordinary shares, and providing for the proportion of the final dividend accrued on the preference shares to May 31st, 1902, there remains a net balance of £20,470 8s. 9d. Of this sum the directors propose to carry £10,470 8s. 9d. to the contingencies account, in order to strengthen the funds available for dealing with further business. This will leave a balance of £10,000, which the directors recommend be distributed as follows:—

Ordinary Shares—			
To the payment of a dividend of 5s. per share for the year ended May 31st, 1902, of which 2s. per share was paid ad interim in December, 1901, leaving 3s. per share to be paid on July 3rd, 1902	£3,000	0	0
To the payment of a bonus of 2s. per share for the year ended May 31st, 1902	£2,000	0	0
Founders' Shares—			
To the payment of a dividend of £50 per share for the year ended May 31st, 1902	£5,000	0	0
	£10,000	0	0

The trustees for the ordinary shares reserve fund propose to distribute to the holders of such shares a sum of 1s. per share out of the proceeds of investments sold and dividends received in respect of such fund, making with the above-mentioned dividend and bonus a total present distribution of 6s. per share, or 8s. for the year on each ordinary share. The trustees for the founders' shares reserve fund propose to distribute to the holders of such shares a sum of £10 per share out of the proceeds of investments sold and dividends received in respect of the fund, making with the above-mentioned dividend a total distribution of £60 on each founders' share for the year. [The above-mentioned payments will be subject

to the deduction of income-tax.] Mr. Emile Garcke retires from his office as director by rotation, and, being eligible, offers himself for re-election. The auditor, Mr. G. T. Rait, also retires, but offers himself for re-election. It is proposed to make the dividends payable on July 3rd, 1902.

The British Continental Electricity Company.

THE directors' report on the position of the undertaking at the end of the year 1901—1902 reads as follows:—

During the year 60 new installations have been connected, while the number of lamps added during this period, calculated on the usual basis of 8 c.p., has been 1,571. The gross receipts from sale of current show an increase of £270 over those of last year, notwithstanding the unfavourable Riviera Season, a result which the directors consider very satisfactory. After writing off £90 8s. 11d. as depreciation in respect of furniture, tools, meters, &c., £75 from preliminary expenses, and £50 from special legal expenses, and placing a further £67 16s. 8d. to reserve fund, the balance standing to the credit of revenue account is £767 2s. 8d. Of the above balance £275 has been absorbed in the payment of the interim dividend at the rate of 5½ per cent. per annum on the cumulative preference shares, leaving a balance of £492 2s. 8d., which the directors recommend shall be appropriated as follows:—By payment of a dividend at the rate of 5½ per cent. per annum on the cumulative preference shares for the past half year, £275; by payment of a dividend at the rate of 2 per cent. per annum for the year on the ordinary shares, £178 10s. 2d.; leaving a balance to be carried forward of £38 12s. 6d.; total, £492 2s. 8d. The sum of £258 1s. 3d. has been spent on additions to plant during the year and £179 12s. 10d. on the purchase of new meters. In accordance with the articles of association, Mr. E. E. Berry retires from his directorship, and, being eligible, offers himself for re-election. The auditors, Messrs. Hercules Nicol & Barker, also retire, and, being eligible, offer themselves for re-election.

West African Telegraph Company.

THE directors' report for the year ended December 31st, 1901, to be presented to the meeting to be held at Electra House, E.C., on Thursday, July 3rd, at 12.15 p.m., reads as follows:—

The company's revenue for that period amounted to £75,554 4s. 6d., against which £20,673 17s. 2d. is charged for ordinary expenses, and £17,720 12s. 9d. for expenditure relating to repairs of cables, &c. After providing £94 19s. 7d. for income-tax, there remains a balance of £37,064 15s., to which is added £322 1s. brought from the preceding year, making a total available balance of £37,386 16s. From this balance there has been deducted £7,568 6s. 8d. for interest on debentures, and £16,566 13s. 4d. for sinking fund, leaving a balance of £13,311 16s., out of which the directors propose to place £18,000 to the general reserve fund, and carry £311 16s. forward to next year. The revenue for the year under review includes a further sum of £12,000 in respect of subsidy due from the French Government, which has not been paid. This arrear, together with the sums withheld in previous years, now amounts to £80,415. Your directors, however, are glad to report that the negotiations with the French Government, referred to in the last report, have been successfully concluded since the date of these accounts, and the first instalment of one hundred and twelve thousand pounds (£112,000), due from the French Government on account of the cables purchased by them, has been received. The director who retires by rotation is Robert Kaye Gray, Esq., who, being eligible, offers himself for re-election.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in Bournemouth and Poole Electricity Supply Company, Limited, 7,500 6 per cent. cumulative second preference shares of £10 each (issued at £1 per share premium), £4 paid (of which £3 is capital and £1 premium); Diesel Engine Company, Limited, 325,000 vendors' ordinary shares of £1 each, fully paid, Nos. 1 to 325,000; and to allow the following securities to be quoted in the Official List:—British Insulated Wire Company, Limited, further issue of 10,000 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 70,001 to 80,000; County of London and Brush Provincial Electric Lighting Company, Limited, further issue of 10,000 6 per cent. cumulative preference shares of £10 each.

Cape Electric Tramways, Limited.—An interim dividend of 6 per cent. has been declared. The dividend will be payable after the receipt of transfer returns from South Africa.

TRAFFIC RECEIPTS.

British Electric Traction Company.—The following returns are issued of the undertakings of this company for the week ending June 13th:—

Company.	Amount	Comparison with corresponding week of last year.		No. of weeks.	Aggregate.		
					Amount.	Inc. or Dec.	
	£	+ £	− £		£	+ £	− £
Devonport*	413	—	—	23½	9,414	—	—
Dudley—Stourbridge	664	—	8	23½	16,104	2,257	—
Gateshead¶	745	244	—	23½	15,664	1,498	—
Greenock-Pt. Glasgow	564	335	—	13½	10,136	5,791	—
Hartlepool	250	4	—	23½	5,037	375	—
Kidderminster ..	105	—	31	23½	2,503	50	—
Merthyr†	200	—	22	23½	4,610	—	650
Middleton*	243	—	—	11½	3,496	—	—
Oldham—Ashton ..	502	15	—	23½	11,538	100	—
Poole†	245	—	26	23½	5,191	—	99
Potteries	1,450	6	—	23½	33,093	1,201	—
Southport	256	103	—	23½	4,725	1,380	—
South Staffordshire†	724	—	37	23½	17,710	466	—
Swansea	450	18	—	23½	10,047	845	—
Taunton*	56	—	—	23½	1,361	—	—
Tynemouth§	259	—	—	23½	5,075	261	—
Wolverhampton Dist.	133	78	—	23½	3,348	2,147	—

* Not in operation last year. † Partly steam. ‡ Comparison from April 5th only. § Comparison from March 18th only. ¶ Comparison from May 8th only.

Blackburn Corporation Tramways.—Week ending June 20th, £817; last year, £636; increase, £181. Total to date, £17,302; last year, £11,931; increase, £2,371. Miles open, 11¾.

Blackpool and Fleetwood Tramways.—Week ending June 21st, £170; last year, £592; decrease, £122. Total to date, £8,316; last year, £9,016; decrease, £701.

Bristol Tramways and Carriage Company.—Week ending June 20th, £4,457; last year, £4,376; increase, £81.

City and South London Railway.—Week ending June 22nd, £3,617; last year, £1,907; increase, £1,110. Total to date (25 weeks), £74,465; last year, £49,139; increase, £25,326. Miles open, 6½; last year, 4¾.

Dublin United Tramways Company.—Week ending June 20th:—D.U.T. Co., £4,594 1s. 8d.; D.S.D. Co, £819 5s. 11d.; total, £4,413 7s. 2d. Last year—D.U.T. Co., £3,834 5s. 0d.; D.S.D. Co, £980 18s. 3d.; total, £4,715 1s. 3d.; decrease, £351 14s. 1d. Aggregate to date, £105,375 6s. 8d.; last year, £102,030 8s. 8d.; increase, £3,344 12s. 0d. Mileage worked, 46.

Liverpool Overhead Railway.—Week ending June 22nd, £1,517; last year, £1,572; decrease, £55. Total to date, £35,798; last year, £39,285; decrease, £3,487. Miles open, 6 miles 57 chains.

Sunderland Corporation Tramways.—Week ending June 22nd, £1,137; last year, £1,061; increase, £76. Total to date (12 weeks), £13,018; last year, £11,949; increase, £1,069. Miles open, 18 7.

STOCKS AND SHARES.

Monday Evening.

WHILE other markets in the Stock Exchange stand with folded arms not expecting the business which never comes, the electrical sections are fairly active. For one thing, the new issue of British Electric Traction shares is creating considerable trade, and electric supply descriptions are by no means left alone. Telegraph stocks, on the other hand, are somewhat neglected, and the reports which have lately appeared from several of the West Indian undertakings are not cheerful enough to arouse any particular interest on the part of the investing public.

It has now become pretty clear that the electric lighting companies will not benefit in consequence of the Coronation to anything like the extent to which it was at first hoped they would. Quotations are steady, and there is a certain amount doing in Brush shares by reason of the proposal of the British Electric Traction Company. We have already referred to the natural indignation aroused in some of those people who sold their shares at prices ranging between 10s. and 15s, these unfortunate sellers being without the information which was possessed by other quarters. Now come doubt and perplexity for the remaining proprietors, who want to know whether they should exchange their Brush shares for Tractions or keep them as they are. In the latter event, the holder must consider the possibility of finding himself in a minority—perhaps a small one—which would mean that his shares might become difficult of negotiation. Under the circumstances, and regarded from the standpoint of share-marketability, it would appear politic to effect the exchange.

New British Electric Tractions are very active, and the price at the time of writing is 2⅛ premium, after being ⅜ higher. The dealers in the market are booking bargains in the shares as fast as they can write, and the extension of the time for sending in applications has been hailed as a simple right. When it was seen, in the first place, that less than seven working days were allowed for getting in applications for the new shares, the arrangement was denounced in exceedingly strong terms. Earnest representations were made to the directors and to the brokers of the company, with the result that the time was dated forward a week, although, as the Coronation festivities intervene, the concession does not amount to much. Obviously, somebody is very anxious indeed to take up the shares which proprietors may miss by reason of their negligence, temporising or unavoidable causes.

Henley's and Callender's are quietly steady, and even now hopes are being revived for the tender union of the companies, of which one of the directors spoke with so much pathetic parable at the meeting the other day. Miscellaneous shares keep idle as a whole. In the electric railway market, hopes of bumper Coronation traffics keep stocks hard, despite the dull tendency developed by the rest of the department. Those who have received the circulars by an outside firm in reference to selling "Tube" shares—including City and Surrey!—might try the Stock Exchange before they attempt to deal with the authors of the circular; they might, possibly, get higher prices.

The telegraph market shows renewed dulness in Anglo-American stocks, and the German competition is still the bugbear of the situation. Eastern varieties are mostly neglected, and there is some curiosity manifested as to how the end of the war may affect the companies cabling to South Africa. The West Indian group is practically unaltered since we last wrote.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME,	Stock or Share. ‡	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation June 18th.	Closing Quotations June 23rd.	Business done during week ended June 23rd, 1902. Highest.	Lowest.
82,300	African Direct Telegraph, 4 % Debs	100	...	...	...	99 —103	99 —103	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3½— 4½	3½— 4½	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	70 — 80	70 — 80	...	...
804,720	Anglo-American Telegraph	Stock	73/6	3½%	61s.	44 — 47	44 — 47	45⅛	44½
3,097,640	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	86 — 88	87 — 89	88¼	86½
3,097,640	Do. do. Deferred	Stock	£1 7s.	5s. %	2s.	6½— 7	6½— 7	6 1/16	6⅜
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	...	3¾— 4¼	3¾— 4¼	...	...
13,333,300$	Commercial Cable	$100	8 %	...	...	165 —175	165 —175	...	...
1,741,029£	Do. do. Sterling 500 year 4 % Deb. Stock Red	Stock	...	..	...	96 — 98	96 — 98	97⅛	96½
16,000	Cuba Telegraph	10	7 %	...	...	4½— 5½	4½— 5½	...	...
6,000	Do. 10 % Pref.	10	...	...	...	12½— 13½	12½— 13½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	2½— 3½	2½— 3½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	8½— 9½	8½— 9½	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	99 —102	100 —103	...	...
60,710£	Direct United States Cable	20	3½%	3½%	...	9½— 10½	9½— 10½	...	...
101,300£	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	120 —130	120 —130	124	121
1,930,807	Do 3½ % Pref. Stock	100	...	...	...	87 — 89	88 — 91	90	89½
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	107 —111	107 —111	109	...
300,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12 — 13	12 — 13	12½	12 1/16
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	108 —113	108 —113	...	...
800,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5¼%	...	...	100 —103	100 —103	102	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	..	...	...	99 —102 %	100 —103	...	...
180,227	Globe Telegraph and Trust	10	5¼%	5¼%	...	8 — 9	8 — 9	...	...
180,042	Do. do. 6 % Pref.	10	...	...	...	12½— 13½	12½— 13½	12⅞	...
150,000	Great Northern Telegraph, of Copenhagen	10	...	15 %	...	25 — 27	25 — 27	...	...
75,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	103 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	37 — 41	37 — 41	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	..	..	100 —104	100 — 104	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680	1	2½%	..	..	¼— ½	¼— ½	...	...
86,492	Do. do. do 5 % Pref., Nos. 1 to 86,492	1	5 %	..	..	¾— 1	¾— 1	..	..
983,333	National Telephone, Pref. Stock	100	5 %	5 %	5 %	95 — 99	95 — 99	97½	...
200,000	Do Pref. shares	2	...	3⅛	3⅜	3⅛— 3⅜	3⅛— 3⅜	...	...
1,966,667	Do Def. Stock	100	...	60	64 xd	53 — 57	53 — 57	...	...
15,000	Do 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 - 14	12 — 14	..	.
15,000	Do 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 - 14	12 — 14	.	..
250,000	Do 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅞ - 5⅛	4⅞— 5⅛	...	...
2,000,000£	Do 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	94 - 97	94 — 97	...	...
500,000£	Do. 4 % Deb. Stock Red.	100	..	4 %	4 %	103 - 107	103 - 107	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	6 %	1⅛— 1 1/16	1⅛- 1 1/16	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's	8	5 %	5 %	...	6½ - 7⅛xd	6½ - 7⅛	...	...
3,303	Submarine Cables Trust	Cert.	...	...	...	110 —120	110 —120	...	...
58,000	United River Plate Telephone	5	7 %	..	...	5 — 5½	5 — 5½	...	...
40,008	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	..	...	4⅝— 5⅛	4⅝ 5⅛	...	...
179,947£	Do. do. 5 % Debs.	Stock	..	..	...	103 —106	103 - 106	..	..
155,600	West African Telegraph, 5 % Debs.	100	..	..	...	99 —102	99 —102	...	..
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	..	...	⅛— ⅜	⅛— ⅜		..
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	..	...	99 —102	99 -102	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	11½— 12½	11½ - 12½	12¼	12
75,000£	Do do. 5 % Debs. 2nd series, 1908	100	...	..	...	102 —105	102 —105	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	..	...	99 —102	99 —102	...	...
88,321	West India and Panama Telegraph	10	5%	..	...	⅝— ⅝	⅜ — ⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	...	..	...	5¼ - 5⅜	5¼ 5⅜	...	...
4,669	Do. do do. 6 % Cum. 2nd Pref.	10	...	..	...	3½— 4½	3½ 4½	...	.
80,000£	Do do do. 5 % Debs., Nos. 1 to 1,800	100	...	..	...	101 —104	101 104		...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord.	1	...	...	...	¼— ½	¼— ½		...
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	...	...	...	100 —104	100 —104	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	8 %	9 - 9½	9 — 9½	...	...
20,000	Do. do. 7 % Cum. Pref.	5	...	...	..	9 - 9½	9 — 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	9 - 10	9 — 10	...	...
50,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼ - 5⅜	5¼— 5⅜	...	...
250,000	Do. do. do. 4% Deb. Stock Red.	100	...	...	..	105 —107	106 —108	107⅜	106⅜
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	5½%	4 %	5 — 5½xd	5 — 5½	...	...
150,000£	Do. do. do. % Deb. Stock Red.	Stock	...	...	...	108 —111	108 —111	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579	10	4 %	0 %	5 %	8 — 9	8 — 9	8½	8⅜
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	11½ - 12½	11½ - 12½	...	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	123 —128	123 —128	...	...
200,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	...	..	...	103 —106	103 —106	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	4 %	7½ - 8½	7½ - 8½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12 — 13	12 — 13	...	...
400,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd.	...	...	...	..	109 -112	109 —112	...	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	...	6⅛— 6⅜	6⅛— 6⅜	...	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5⅝— 6⅛	5⅝— 6⅛	...	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	...	..	108 —111	108 —111	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	11%	12%	10%	10 — 11	10 — 11	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	..	1⅛— 1⅜	1⅛— 1⅜	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	...	..	4 — 4½	4 — 4½	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	94 — 99xd	94 — 99	...	...
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	6½%	16 — 19	16 — 17	16½	...
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	111 —115	111 —115	..	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	98 —101	98 —101	...	...
8,652	Notting Hill Electric Lighting	10	7 %	7 %	6 %	14 — 15	14 — 15	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14½— 15½	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	...	...
150,000£	Do. do. 3½ % Deb. Stock Red.	100	...	...	...	98 —101	98 —101	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	1⅞— 2¼	1⅞— 2¼	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2¾— 3¼	2¾— 3¼	...	...
109,518	Westminster Electric Supply, Ord.	5	13 %	10½%	10½%	11 — 12	11 — 12	11 1/16	11 3/16

* Subject to Founders Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year, consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation June 18th.	Closing Quotation June 23rd.	Business done week ended June 23rd, 1902. Highest.	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	† 10	...	...	...	4½ — 5½	4½ — 5½	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	86 — 90	86 — 90	...	...
62,074	British Electric Traction	10	8 %	9 %	9 %	13½ - 14½	12½ - 13½	14	13
90,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12⅝ — 13	12 — 12½	12⅝	12⅜
600,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	..	124 —127	124 —127	126	124
70,000	British Insulated Wire Ord.	5	20 %	15 %	10 %	7½ — 8½	7½ — 8½	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5½ — 6	5½ — 6	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	8 %	...	13s. to 15s.	13s. to 15s.	...	...
50,000	¶ " " " 6 % Cum. Pref.	£1	...	6 %	...	16/6 to 17/0	16/6 to 17/0	...	...
105,731	Brush Elecl. Enging., Ord., 1 to 105,731	2	5½ %	5 %	Nil	1⅛— 1⅜	1⅛ — 1⅜	...	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	3 %	1⅞— 2¼	1⅞ — 2¼	2	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
125,000*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	95 —100	95 —100	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	20 %	16 — 17 xd	16 — 17	...	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5⅜ — 6¼	5⅜ — 6¼	...	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ..	Stock	...	...	...	111 - 115	111 —115	112	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	4 %	104 —107	104 —107	105⅝	...
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	4 %	103 — 106	105 — 108	..	...
440,100	Do. do. Def. do.	Stock	...	...	4 %	100 — 103	100 — 103	..	...
855,000	City and South London Railway	Stock	1⅞%	1¼%	2 %	71 — 74	71 — 74	72⅛	71
54,000	Crompton & Co., Nos. 1 to 54,000	3	7½%	8 %	...	3 — 3½	3 — 3½	3⅛	...
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	103 —108 %	103 —108 %	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½%	...	⅛— ⅜	⅛ — ⅜	...	.
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	2½%	...	1½ — 2½	1½ — 2½	...	.
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	75 — 80	75 — 80	.	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	82 — 87	82 — 87	.	.
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1½— 1⅝	1½ — 1⅝	...	...
31,390	Do. do 7 % Cum. Pref., 1 to 31,390... ...	2	...	..	...	2½— 3	2½ — 3	...	..
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	..	...	97 —101	99 —102	..	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	..	...	10 — 10½	10 — 10½	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	98 —101	98 — 101	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	20 %	16½ — 17½	16½ — 17	16⅞	...
35,000	Do. do. do. 4½ % Pref.	5	4½%	4½%	...	5½— 6	5½— 6	...	...
50,000*l*	Do. do. do. 4½ Mort. Deb Stock...	Stock	...	..	.	111 —115	111 —115	...	
50,000	India-Rabber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	...	...
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	..	...	99 —102	100 103	10 ⅛	
37,500	†Liverpool Overhead Railway, Ord.	10	3⅛%	3⅛%	1⅛%	4 1⅛— 4 1⅛	4 1⅛ 4 1⅛	..	.
10,000	† Do. do. Pref., £10 paid	10	5	...	..	10½ - 11	10½ 11	...	.
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500	10	...	...	..	... — 16⅜	... —16⅜	...	...
	§Rosling & Fynn 6 % Cum. Pref.	£1	...	6 %	.	... — ...	19/0 to 20/0	...	
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	20 %	34 — 37	34 — 37	...	...
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...%	..	...	103 —106	103 —106	...	..
25,000	Telegraph Manufacturing, Ord. Nos. 1 to 25,000	5	12 %	12 %	.	9½ — 10⅛	9½— 10½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000 ..	5	...	.	...	5½— 6	5½— 6	...	
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	93 — 96	93 — 96	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ⅛—⅜.
National Electric Free Wiring, —1.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14½—15
Do do. Pref. (£10 pd.), 10⅜—10⅝.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 3 per cent (February 6th, 1902).

MARKET QUOTATIONS, Monday, June 23rd.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a " Nitric	per cwt.	22/-	22/-	..
a " Oxalic	per cwt.	32/-	32/-	..
a " Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	42/-	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£88 10	£88 10	..
a " " ..	per ton	£80	£80	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£18	£18	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a " (50/90%).. ..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£19	£19	..
a Lead, Nitrate	per ton	£24	£24	..
a " White Sugar	per ton	£81	£81	..
a " Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8d.	8d.	..
a " Caustic (76/80%) ..	per ton	£24	£24	..
a " Bisulphate	per ton	£85	£85	..
a Shellac	per cwt.	110/-	110/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5	£6 5	..
a " Recovered	per ton	£5 10	£5 10	..
a " Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a " Crystals	per ton	£3	£3	..
a Bichromate, casks ..	per lb	2½d.	2½d.	..
METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b " Wire, in ton lots	per ton	£224	£224	..
b " Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£40 to £140	£40 to £140	dec.
c Brass (rolled metal 3" to 12") basis	per lb.	6¾d.	6¾d.	..
c Tube (brazed)	per lb.	8¼d.	8¼d.	..
c " (solid drawn) ..	per lb.	7d.	7d.	..
c " Wire, basis	per lb.	7d.	7d.	..
c Copper Tubes (brazed)	per lb.	8¾d.	8¾d.	..
c " " (solid drawn) ..	per lb.	9d.	9d.	..
g Copper Bars (best selected) ..	per ton	£69	£69	..

METALS, &c. (*continued.*)		This week	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£69	£69	..
g " Rod	per ton	£69	£69	..
c " Electrolytic) Bars ..	per ton	£63	£63	..
c " " Sheets ..	per ton	£75	£75	..
c " " Rod ..	per ton	£68	£68	..
c " " H.C. Wire	per lb.	8d.	8d.	..
f Ebonite Rod	per lb.	8/-	9/-	..
f " Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/6	1 5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	2/11½ to 3/0½	2/11½	inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i " Pig (Cleveland warrants) .	per ton	49,8	49 8	..
i " Forgings, according to size	per ton	From £11	From £11	..
i " Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i " Wire, galvanised No. 8 ..	per ton	£9 15	£9 15	..
g Lead, English Ingot	per ton	£11 7 6 to £11 10	£11 7 6 to £11 10	..
g " " Sheet	per ton	£13	£13	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot	£8 15	£8 15	..
d Mica (in original cases), small ..	per lb	8d. to 9d.	8d. to 9d.	..
d " " " medium	per lb	1/9 to 2/9	1/9 to 2/9	..
d " " " large ..	per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb	11½d. to 1/2	11½d. to 1/2	..
p " rolled bars & rods	per lb.	1/- to 1/8	1/- to 1/8	..
p " " strip & sheet	per lb.	From 1/2	From 1/2	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	9d. to 1/-	9d. to 1/-	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15 to £40		..
i " " in bars		£58	£58	..
g Tin, block	per ton	£127 to £129	£127 to £129	..
g " foil	per lb.	1/6	1/6	..
m " wire, Nos. 1 to 16	per lb.	1/7	1/8	1d. dec.
p White Anti-friction Metals —				
"White Ant" brand .. .	per ton	£35 to £65	£36 to £60	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j " 6 les. Flax	per lb.	5⅝d.	5⅝d.	..
j " 3 ply 12 lbs. Russian ..	per lb.	5½d.	4½d.	..
j " 10 lbs. Russian, single ..	per lb.	4¾d.	4¾d.	..
j " 180 lbs. Jute rove	per ton	£10 2 6	£10 2 6	..
k Zinc, Sh's. (Vielle Montagne bnd.)	per ton	£22 10	£22 10	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Edward Till & Co. i Messrs. Bolling & Lowe. j Messrs. Walter H. Hindley & Co.

Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company, Ltd.

* Subject to Founders Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year, consisting of the latter part of one year and the first part of the next.

THE DEFENCE OF THE POST OFFICE.

Mr. Austen Chamberlain and the "Breach of Faith."

By Chas. H. GARLAND.

The telegraphists, in common with other postal employés, are pressing for a Parliamentary inquiry into the grievances of which they complain. By a Parliamentary inquiry they mean an inquiry with a composition affording guarantees of impartiality, and they have pledged themselves to abide by the findings of such a Committee. Their allegations are met by the Postal Department with a denial or a *non possumus*. They therefore ask for what would practically be a Board of Arbitration, which is a legitimate and well-recognised means of settling industrial disputes.

The debate which took place in the House of Commons on the Telegraph Vote proved one thing beyond question. Whatever view may be taken of the truth of the allegations of the telegraphists, or the reality of their grievances, and whatever value may be attached to the counter-statements of the Postmaster-General's representative, there was no doubt that a *primâ facie* case was made out for arbitration. A "breach of faith" was charged against the Postal Department by Captain Norton, and documentary evidence was adduced in support of the charge. The hon. and gallant member for Newington was supported in his view by the Hon. Claude Hay and Sir Albert Rollit on the Conservative side of the House, and by numerous speakers on the Liberal benches. The division proved subsequently that a total of 134 members took the view of Captain Norton.

Mr. Austen Chamberlain, of course, denied the "breach of faith," and rather superfluously added that: "If he thought for a moment there had been such a breach, he should not be there to defend the Department, nor would his noble friend, the Postmaster-General, ask him to do so." The division brought him 165 supporters, and as the tellers for the "noes" were the official whips of the party, it is fair to assume that other reasons than conviction influenced many of the voters.

That the huge majority of the Government should be reduced to 31 on so serious a charge as that of a breach of faith is sufficiently significant. When, in 1890, Mr. Raikes was Postmaster-General, and the Government majority was much lower than it stands at present, Lord Compton's motion for reform was defeated by 39. Yet Mr. Raikes thought it wise to yield to the strong feeling in the House, and revised the conditions of service. But the main point lies here: 134 members of the House of Commons have recorded their belief that there has been a distinct breach of faith. Mr. Austen Chamberlain and his supporters, without adducing much in the nature of rebutting proof, deny this. Here, then, is a very ideal case for inquiry and award. It is a question of fact, and a Committee going into the whole of the evidence could settle the matter once for all. Until such an inquiry is made the charge will continue to be urged on the one side and denied on the other, with progressively increasing vehemence and bitterness.

One misses with Mr. Austen Chamberlain that dialectical skill and quiet reasoning power which commanded for Mr. Hanbury the respect of those from whom he differed in opinion. The present Secretary to the Treasury seeks rather to copy his father's style, but the copy, like all imitations, lacks much of the merit of the original. Mr. Austen Chamberlain, during this last debate on Postal matters, did little more than offer a blank contradiction to the assertions of the supporters of Captain Norton. He did not deign to adduce the slightest evidence in support of his position, and only once did he so far forget himself as to quote figures. I hope to show later that these few figures are incorrect, and the arguments founded upon them fallacious. The spirit of dogmatic contradiction seemed to grow upon him as the evening advanced, and culminated in a characteristic little colloquy between himself and Mr. Duke, the Conservative member for Plymouth. Mr. Duke very mildly suggested that "He did not think anybody in this country believed that the postmen were generously treated. At least, if there were such, he had never met them. If the Secretary to the Treasury thought that the postmen were generously treated, he hoped the hon. gentleman would say so." Mr. Austen Chamberlain, from his seat below, looked up with a smile of confidence, from which there was not lacking something of pride, and interpolated: "I certainly do." So soon as Mr. Duke recovered from his surprise, he made the obvious retort: "I can only say, with equal emphasis, I certainly do not!" This little incident is merely quoted as typical of the spirit in which the allegations were met. Now let us look for a moment at the grounds of the alleged "breach of faith."

Captain Norton's case was, briefly, this: During the years between 1881 and 1890 men were induced to enter the telegraph service by a promise made on behalf of the Postmaster-General by the Civil Service Commissioners. This was what was stated in the paper:—"The Civil Service Commissioners are authorised by the Postmaster-General to append the following notice." Then followed an enumeration of certain payments during the very earliest years, and the notice continued as follows:—"After a year at 16s. a week, to advance to £45 a year, rising by £5 to £100, with a prospect of obtaining £190." The course of events has rendered it humanly impossible, without some radical alteration in the present methods of promotion, for more than a very small percentage ever to obtain this £190 per annum. In Captain Norton's own words, "The Government finding their business developing, found it also convenient at the same time to ask the senior telegraphists (*i.e.*, the telegraphists on that part of the scale from £160 to £190) to take a certain share of what were known as supervising duties." Following on this, by successive innovations, the senior class of telegraphists was converted into a supervising class. By this means it was made possible to escape from the recommendation of the Tweedmouth Committee to abolish classification between non-supervising classes, and now the majority of the men who entered between 1881 and 1890 find themselves debarred from any possible realisation of the "prospect of £190," promised to them on the authority of the Postmaster-General. The Department contends that this prospect still exists, although admitting it may be as remote as the marshal's bâton from the private soldier. Sir George Murray, the secretary, indeed suggested another way of realising the prospect. "Suppose," said he, "we had an epidemic of influenza in London next winter, and a large number of those men who had got into the higher class died off, would it not be possible then to attain to this position?" The proximity of a Mont Pelée might offer as ready a means of assisting the Department to keep faith with its employés.

Mr. Austen Chamberlain, after the protestation already quoted, continued thus: "Those men who joined the service between 1881 and 1890 were the only persons who, in any case, could complain of a breach of faith. The promise was that they had a prospect of rising to £190. The hon member said this offer was an unfair one. I suppose it would not be unfair to say that an officer joining the British army has a prospect of becoming a field marshal, but that does not mean that every officer will become a field marshal or even a general. This was put before them as a prospect to which some of them might attain. I think that the Committee will see that, under these circumstances, the telegraphists never received a definite pledge that they would have this £190."

The "prospect" was held out to every man entering the service, and as we have a responsible official as highly-placed as Sir Geo. Murray, admitting that nothing short of an epidemic can make the salary attainable, this distinction between a "prospect" and a "definite pledge" can hardly carry conviction. It simply shows how hard pressed Mr. Austen Chamberlain and his advisers must be that they should resort to such arguments.

In the next few sentences we get the only attempt at citation of facts that occurred during the evening, and I will quote the passage:—"All they were told," said the Secretary to the Treasury, "was that there was a prospect of rising to £190, which was beyond the scale set out. The very words chosen showed that all of them would not reach that amount, and they had no right to complain. If there are now the same proportion of men on the scale as when the circular was issued, surely there can be no ground of complaint. I am trying to put the case as frankly and as fairly as I can. I do not wish to leave any doubt in the mind of the Committee as to the exact point at issue between us, and I wish to meet that point fairly. The question is whether the prospect of attaining this higher position has become worse than it was. The hon. and gallant member for Newington has assumed that I shall endeavour to escape from the meshes by some disingenuous subterfuge. I will, however, do my best to meet the case fairly. Under Mr. Fawcett's scheme the number of situations above the maximum of £160 limit was 168, and it bore a proportion to the total number of telegraphists below the senior class of one to six and a third. In 1890 the proportion was exactly the same. At the present time the total number above the limit is 349, and the number below is 2,076, according to the latest figures. I ought just to say that I am not quite certain that my figures are up to date, but they are the most recent, and I think the proportion is practically the same at the present time."

The £190 was not "beyond the scale set out." It was a part of the operators' scale set out in the Civil Service Commissioners' note, and access to it was obtained, as explained by Sir Henry Fischer, the late controller of the Central Telegraph Office, in a note dated January 10th, 1896. "Ordinary manipulative ability," he said, "combined with regular attendance and good conduct, were considered sufficient qualifications for promotion to the Senior Class."

The first statement may be dismissed, then, as unfortunate. But the next statement is more definite. Is it the fact that the proportions are the same as during the period of the issue of the promissory circular? The contention of the telegraphists is this:—Apart from the general claim that the arbitrary barrier to promotion to the £190 class should be removed, there has been an actual decrease in the proportion of senior appointments relative to the general body. In support of this contention official figures are quoted, which can be tabulated as follows:—

Year.	Number of general body.	Number of senior appointments.	Proportion of general body to each senior appointment.
1881	966	126	7·66
1886	1,224	161	6·60
1888	1,321	175	7·54
1890	1,590	219	7·26
1892	1,740	170	10·23
1897	1,870	172	10·87
1902	2,087	170	12·27

* The promise made was that £190 could be obtained *as an operator*. On the 1881 establishment one man in 7·66 could obtain this salary In 1902 the prospect is reduced to 1 in 12·27.

Now see how Mr. Austen Chamberlain seeks to escape from these official figures. He says the proportion of *appointments above* £160 is the same as in 1881. This is not literally true; but let us accept it for the moment, and see how he arrives at it. He adds together all the supervising appointments with the senior appointments.

This method begs the very question at issue. The development in the mass and complexity of the work has necessitated the increase of supervising appointments, and the benefits of this increase should, in common justice, go to the staff that bears the burden of the increased toil. But instead of increasing the supervising appointments, the Department has thrust a part of the supervising work upon the operators' class, and pays for it on what was intended to be an operator's scale. In so doing it has reduced the prospect of rising to £190 as an operator. It cannot be too emphatically declared that £190 is the *operators'* maximum, promised to entrants on the authority of the Postmaster-General. To declare that it can be reached only as a supervising officer is practically to admit the breach of faith. To keep faith, the Department must prove that it is humanly possible to reach this salary as an operator. Instead it has actually reduced the chance from 1 in 7·66 to 1 in 12·27, and even this reduced chance is accompanied by a demand for a higher class of work and knowledge than was mentioned in the contract.

This was Mr. Austen Chamberlain's only incursion into the realm of facts and figures, and he can hardly be said to have sustained his position. The way out of this endless controversy is obviously the way that the telegraphists themselves suggest: an inquiry into the whole facts by an impartial committee. It would surely be to the interest of the department to have so serious a charge as that of broken faith cleared away.

It is with some amusement, rather than alarm, that we listen to the threats of disfranchisement which are hurled at the postal employés because of what is called the "pressure" they exert on members. The pressure of the 40,000 organised postal workers scattered over a total of some 770 constituencies cannot represent much voting pressure. The pressure must, therefore, arise from well-argued grievances. To threaten disfranchisement of civil servants on these grounds is hardly logical, and certainly unjust. Times out of number the men have been told that the "House of Commons is their Court of Appeal" (Mr. Hanbury). Surely, then, it is unwise to threaten postal servants for using this Court. But let us suppose that the House of Commons did disfranchise Postal servants. There are 174,000 of them, and the object would be to punish the 40,000 who are organised. But there is widespread discontent, and the outlet for that discontent is an appeal to Parliament. The Postal staff are content with that outlet because they feel sure they are slowly gaining ground. So they send their delegates to conferences, Trades Union congresses, affiliate with public bodies, and are now preparing to send a member to the House of Commons itself. This is a legitimate constitutional method of promoting reform. Suppose we close these avenues, would not discontent find other outlets less conducive to good citizenship? Before this outlet was discovered we had the telegraph strike of 1870, the rioting on Post Office buildings in 1873, and the postmen's strike of 1890. I think it will be admitted that the present methods are preferable, and it would be an ill day if the unquenchable expressions of discontent were turned from the present constitutional channels into the older and more harmful paths. These considerations are known to those in authority, so we can afford to smile at the empty threats of Mr. Gibson Bowles and Mr. Banbury. There is a surer method of silencing discontent—impartial inquiry.

ON THE DETERMINATION OF THE IRREGULARITY FACTOR OF ENGINES.

By Dr. RUDOLF FRANKE.

A Paper read before the Verband Deutscher Elektrotechnicker at Dresden.

Translated from the *Elektrotechnische Zeitschrift*, October 24th, 1901.

(*Concluded from page* 961.)

In the Electrotechnical Institute of the Stuttgart Tech. High School this method is used for determining the irregularity factors of galvanometers by recording and fixing the swings of the needle photographically on a length of sensitised paper drawn past. As, however, every galvanometer possesses a natural time of swing, the curve obtained is never free from error, as it represents the result of a combined motion. If one attempts to avoid the effects of the natural period of the galvanometer either by using the so-called oscillograph (galvanometer with a very short periodic time), or by replacing the galvanometer needle by the massless stream of cathode rays from a Braun tube, one at once finds, unfortunately, that the sensitiveness of such arrangements is far too small for the purpose. One method still remained untried, viz., replacing the galvanometer by an alternate current instrument.

One can, in fact, consider an irregular continuous current as made up of a perfectly uniform continuous current and a superposed alternating current. If, therefore, the continuous voltage is compensated by a back voltage as in fig. 8, the alternating current can be measured by a suitable instrument, and the irregularity factor obtained directly. In this connection it is, however, necessary to remember the following: Even with perfectly uniform rotation every continuous current dynamo gives a non-uniform voltage, partly due to the short-circuiting of the sections in turn under the brushes, and partly due to irregularities in the spacing of the wires and in the strengths of the magnetic fields. The alternate current instrument is affected by these irregularities, which are, however, essential to the construction of continuous current machines. One could, of course, avoid this difficulty by retesting the dynamo when running at a uniform speed, or by using a unipolar machine without commutator. But then, again, alternate current instruments fail altogether through want of sensitiveness. We must, therefore, fall back upon continuous current instruments, and overcome the troublesome effects of their natural period by other means

I suggested a method at the 1899 meeting of the Verband Deutscher Elektrotecknikker which admits of a high degree of accuracy, and avoids the errors due to natural period. It is based on the principle of the Joubert contact method of determining the instantaneous voltages. The actual arrangement is shown in fig. 9,

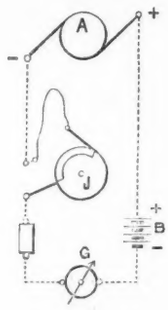


Fig. 9.

which only differs from fig. 8 in having the interrupter J coupled in the circuit. This is coupled directly to the engine under test, and it serves to close the circuit through the galvanometer for an instant in each revolution at a definite position of the crank.

This produces a throw on the galvanometer which is proportional to the voltage existing at that instant, and, therefore, also to the angular velocity.

If the brushes are set in another position the momentary contact occurs at another instant, and therefore at another angular velocity. One can, therefore, determine the instantaneous speed at as many consecutive points as are considered necessary. It would be possible to carry out this compensation method test with much greater accuracy if the variable time of revolution did not again interfere disastrously. This causes the instantaneous speed to be different in every revolution, so that instead of a steady E.M.F., a constantly varying one is obtained

The arrangement shown in fig. 10 was hit upon in order to overcome this difficulty. It enables the variable time of revolution to

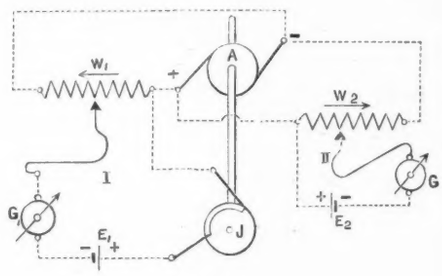


Fig. 10.

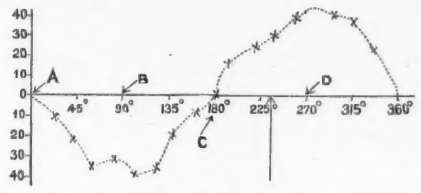
be taken into account, and its effect to be determined at every instant. For this purpose, the terminals of dynamo A are closed by two high resistances, w_1 and w_2, coupled in parallel, thus forming two circuits. By means of the voltage drop in w_1, the counter E.M.F., E_1, is compensated for the moment at which the circuit is closed through the galvanometer, G, by means of the interrupter, J. This, therefore, measures instantaneous speeds. By means of the voltage drop in w_2, the counter E.M.F., E_2, is compensated by the help of the galvanometer, G_2, which should not have too short a time of swing nor too little damping. Galvanometer G_2 is, therefore, only actuated by changes in the number of revolutions, or, more exactly, in the time of revolution.

If, now, all observations in circuit (I) are made only when galvanometer, G_2, in circuit (II) indicates zero deflection, these observations will all be reduced to a common time of revolution. For this purpose two observers are necessary, and it is also, of course, necessary to eliminate those irregularities in voltage due to the construction of the dynamo by means of a separate experiment. This method is perhaps the only satisfactory and accurate one for the measurement of such small irregularity factors as $\frac{1}{200}$.

Fig. 11 represents a velocity curve taken in this way. It refers to an artificial irregularity of about $\frac{1}{100}$, produced by attaching a weight to one side of the pulley of an electric motor coupled to the dynamo. The positions of the weight are stated on the curve.

One can plainly notice a want of symmetry at "Weight above," which showed itself by a knock at the bearing in the direction of

the axis once in every revolution. The highest velocity does not occur at the moment when the weight is lowest, but a little later, a peculiarity due to the motor having back E.M.F. and self-induction. The curve is the result of four sets of tests involving much



Ordinate 1,060

A, Weight horizontal rising; B, Weight above; C, Weight horizontal falling; D, Weight below.

FIG. 11.

trouble and occupying almost a week. It will therefore be readily seen that this method also is unfitted for practical use, because of the very great amount of patience required on the part of the experimenters.

The methods of the third class have, therefore, also failed to satisfy the requirements. I may, therefore, on the strength of my experience up to the present, state it as a fact that it is impossible with our present technical resources to measure smaller irregularity factors than $\frac{1}{100}$.

Even though the investigations in this direction, for the purpose of discovering a practical method of measuring irregularity, have failed, I shall still feel satisfied if they at least have the effect of discouraging others from any troublesome, costly, and at the same time, fruitless experiments.

It follows that the electrical engineer and the engine builder will not be able to bury the hatchet yet, as the problem of the determination of the irregularity factor remains unsolved.

We may, however, perhaps be able to settle this dispute in another way.

If we put the question to ourselves: What does the irregularity factor mean to the electrical engineer? We shall receive a reply indicating two distinct reasons in favour of a definite minimum irregularity. Firstly, in order to avoid fluctuations or pulsations in the light in a lighting installation; and secondly, in order to make satisfactory parallel running possible with alternators. With regard to the first reason, I would refer to a communication by Prof. Friese* to the general meeting of the Verein Deutscher Ingenieure. In this it is shown that light pulsations vary with the sixth power of the potential difference, and that therefore the irregularity factor might, under certain circumstances, become very noticeable. Friese has remarked that the sensitiveness of persons to fluctuations of light increases with their intelligence, and to this I would add—also with their technical skill, as well as nervousness, which, unfortunately, is intimately connected with intelligence. From his observations, Friese came to the conclusion that irregularity factors of $\frac{1}{200}$ were very good, whilst those of $\frac{1}{65}$ were quite unbearable. We have, however, numerous cases of gas engine-driven light installations, in which irregularity factors of $\frac{1}{80}$ to $\frac{1}{120}$ have been found quite suitable, and in no way objectionable. Under these circumstances it would usually be unnecessary to go lower than $\frac{1}{200}$, and one may consider this as the outside limit for lighting installations, whilst $\frac{1}{100}$ would, in most cases, be sufficient.

The irregularity factor appears to be of far greater importance in connection with the parallel coupling of alternators, in which the setting up of surgings between the machines can generally be traced back directly to the irregularity factor. I would refer here to the older contributions to this subject of Boucherot,† Blondel,‡ and Hutin and Leblanc,§ and the newer work of Messrs. Kapp,‖ Benischke,¶ and Görges**

When alternators are coupled together we have to distinguish between the two following cases:—

A machine with an irregular rotation working in parallel with a machine without any irregularity, or with a supply system having a constant pressure, or

Two machines with irregular rotations working in parallel.

In both cases surging, *i.e.*, the appearance of periodically rising and falling equalising currents between the machines, is found, and under certain circumstances these may cause the complete falling out of step of the machines.

The irregular rotation of the engine causes the alternator to swing to and fro about the average condition of motion with a periodicity equal to that of the irregularity. In this way phase differences in the voltage curves of the machines occur, and may be considered as the cause of the equalising currents. We have next to deal with interferences called forth by enforced fluctuations.

If, over and above this, one of the machines possesses the power, when disturbed from its normal conditions of motion, of re-adjusting itself or even overstepping the mark in the opposite direction, *i.e.*, if one of the machines has a natural swing of its own, it is possible for this latter to become increased through the enforced fluctuation due to the engine irregularity. We are then dealing with a resonance effect. This is usually the most dangerous condition.

The possibility of a natural swing in an alternator is due to the presence of inertia and the dragging forces acting on the rotating parts. The former depends on the construction of the machine, the dragging forces are determined by the alternating action between field magnet and armature, and therefore depend on the excitation and the load.

The predetermination of the natural period of the machine has been already repeatedly attempted (see the above-mentioned articles), and Prof. Görges, in particular, has published a quite practical method. Unfortunately, in none of these articles is any notice taken of the reciprocating parts of the engine, which are, however, connected with the rest of the moving parts, and therefore take part in the periodic fluctuations. As, on this account, the moment of inertia of the machine as well as the effect of the elastic steam or gas contained in the cylinders of the engine cannot be calculated, I agree with the view taken up by Dr. Benischke to the effect that the predetermination of the natural period of an alternator is an impossibility.

Now, resonance effects are not so much dependent on the amount of the irregularity as on the agreement of the periodicity of the irregularity with the natural period of the machine; for experience has shown that parallel running can be carried on with machines having small as well as with those having large irregularity factors.

An increase in the amount of inertia should only be used as a safeguard against resonance when the natural period is advantageously altered by this means. Very frequently the opposite is the case, a reduction of the moment of inertia alone giving the desired result, unless one is prepared to introduce other means, such as choking coils, Le Blanc damping circuits, &c.

Experience has further shown that it is unusually difficult to connect alternators direct coupled to gas engines in parallel, and the cause given for this is the great irregularity factor of the gas engine. We must consider, however, that in a gas engine the number of revolutions or, more correctly, the time of revolution is continually varying—as more particularly pointed out in the first part of this paper—due to the occurrence consecutively of explosions of unequal force and the consequent unequal development of energy.

On this account, with machines coupled in parallel, sometimes one and sometimes the other must get ahead, and it is clear that here an interference action exists which is only remotely due to the irregularity factor.

For all interference actions the effect of the irregularity factor is altogether overrated, as will be seen from the following considerations:—

The equalising currents passing between two machines in consequence of irregularity tend to accelerate the lagging machine and to retard the leading one.

If now, on the one hand, we fit the machine with heavy flywheels in order to reduce the irregularity factor to a minimum, we, on the other hand, immediately hinder it from following the promptings of the equalising currents and so righting itself, for it is impossible to suddenly accelerate or retard such large masses.

We see, therefore, that the introduction of heavy flying masses may have a distinctly harmful effect on the running of alternators in parallel. This also applies to the case in which load changes occur on one machine, and cannot be immediately equalised by the other machine, because of its too great moment of inertia. It must further be remembered that the quickness of response to the governing arrangements becomes less the greater the fly-wheel action of the machine is made, *i.e.*, governing becomes more difficult, and even impossible.

We may recognise from these cases that it is probably possible, even with alternators in parallel, to get on with comparatively large irregularity factors such as $\frac{1}{100}$, or at the outside $\frac{1}{200}$. Experience is, of course, here again the best teacher.

All electrical engineers would, in my opinion, be greatly indebted to electrical firms which would publish their experience in this direction, more especially with regard to installations in which difficulty is or has been experienced in the paralleling of alternators, for it is only from such and not from successfully-working installations that we can learn what we require.

In conclusion, I would summarise my views as follows:—

1. Every engine possessing an irregularity is also subject to a varying time of revolution, which often fluctuates more than the irregularity itself.

2. It is practically impossible to determine irregularity factors smaller than $\frac{1}{100}$.

3. It is unnecessary for electrical engineers to demand smaller irregularity factors than $\frac{1}{200}$, as experience has shown that we can get on with greater irregularities. The advantage resulting from this would be: cheaper machines, and governing more to the purpose.

I shall be greatly pleased if I have been able to help in any way towards the clearing up of this important question.

* *Zeitsch. d. Ver. Deutsch. Ing.*, 1899, No. 39.
† *La Lumière Electrique*, Vol. 45.
‡ " " " Vols. 45 and 46.
§ " " " Vol. 46.
‖ *Elektrotechnische Zeitschrift*, 1899, Part 7.
¶ " " 1899, Part 50.
** " " 1900, Part 10.

TRADE NAMES.

A NUMBER of recent cases have illustrated the fact that the selection of a suitable, and, at the same time, a legitimate name for a concern is a matter of no small difficulty. The manufacturer has not only to select a title which shall adequately describe the nature

of his business, but he has to take care that in doing so he does not assume a name to which some trade rival has obtained a right by prescription or otherwise.

The difficulty of this question is to some extent less in the case of a limited company selecting a name than it is when a private firm is about to adopt a title. The reason for this is that a company is expressly prohibited by the Companies Act, 1862, from assuming any title which is the same as, or only colourably different from that which has been assumed by any other company. Further, the question of fraud hardly enters into the discussion. But in the cases between rival traders having the same or somewhat similar appellations, it often becomes material to consider the motive which actuated any person in adopting a particular name. Thus, if a man sets up in business under his own name, or takes in a partner whose name coupled with his own causes the title to resemble that of a rival firm, and he does all this with the fraudulent intention of injuring the rival, the Court will restrain him by injunction.

Thus in one case a man named Martin went into partnership with a man named Day with a view to carrying on a blacking business in competition with the well-known firm of Day & Martin. The Court granted an injunction to restrain him from so doing, although it was clear that part of the title was his own name. Fraud, of course, was the essence of the case. Certain recent cases to which we shall now refer, go to show that the Court will not protect a company in the use of a name which embodies some word of general application, and which is of common use in relation to a particular industry. In the case of Aerators, Limited, *v.* Tollit, which was heard by Mr. Justice Farwell on May 29th, the plaintiffs were a company established for the purpose of making "sparklets," and the defendants were the signatories to the memorandum and articles of association of a proposed new company, to be known as the Automatic Aerator Patents, Limited. The plaintiff company, on hearing of the proposed registration of the new company, decided themselves to register a new company under an identical title, as they objected to its use by the defendants, but were too late in their application; and they then decided to move for an injunction to restrain the defendants from registering a company under that title, or with any other name so nearly resembling that of the plaintiff company as to be calculated to deceive. The plaintiff company rested their case on the fact that they had carried on business for some time and had spent large sums in advertising the company in England and the Colonies, and that the word "Aerators" was generally known as a company that possessed the principle of instantaneous automatic aeration, and that the adoption of that name by the defendants would be calculated to lead the public to believe that it was the business of the plaintiffs. The defendants contended that the system of aeration they proposed to adopt was entirely different, and therefore was not calculated to deceive. It was held that the rights conferred by Sec. 20 of the Companies' Act, 1862, were not greater than those of individuals in respect of names not identical but similar, and that "calculated to deceive" was a question of fact in each case; and that it was not competent to a company by registering a single word to remove it from the language so far as regarded its use in subsequent companies. There was here no evidence of any probability of deception; the action was therefore an attempt to monopolise for the purposes of nomenclature a word in ordinary use in the English language. It failed, and was dismissed with costs.

The case of the American Shoe Company, Limited, *v.* the British and American Shoe Company, Limited, which was heard on May 14th, illustrates the principle that the Court will restrain the wrongful use of a name. There the plaintiffs were a limited company carrying on a large business as manufacturers of, and dealers in, boots and shoes. The defendants commenced business in Putney under the style of the "London American Shoe Company"—a title which they subsequently altered to that in respect of which they were sued. The case for the defendants was put forward as that of three young women who had lost their mother, and who had been compelled to earn their own living, oppressed by a large company who were trying to establish a monopoly in the use of certain common English words. This view of the facts did not commend itself to Mr. Justice Swinfen Eady, who said: "Having examined the evidence, I come to the conclusion that the defendants did not act innocently either in originally choosing the name, the London American Shoe Company, or, when asked to alter it, in substituting the British and American Shoe Company, and that they did not entirely cease to use the former name, which they had promised to do. . . . . I also overrule an objection that the plaintiffs were seeking a monopoly of descriptive words. . . . . The jurisdiction is founded upon the power of the Court to restrain fraud. A man can be restrained even from using his own name fraudulently." He therefore granted an injunction to restrain the defendants from using either the name, London American Shoe Company, or British and American Shoe Company.

THE PROGRESS OF ELECTRIC SPACE TELEGRAPHY.*

By G. MARCONI.

Wireless telegraphy, or telegraphy through space without connecting wires, is a subject which at present is probably attracting more world-wide attention than any other practical development of modern electrical engineering.

That it should be possible to actuate an instrument from a distance of hundreds or thousands of miles and oblige it at will to reproduce audible or visible signals through the effects of electrical oscillations transmitted to it without the aid of any continuous artificial conductor, strikes the minds of most people as being an achievement both wonderful and mysterious.

If we examine the subject closely, we may, however, come to the conclusion that, although telegraphy through space is certainly wonderful, as are likewise all natural and physical phenomena, yet it is certainly in no way more wonderful than the transmission of telegrams along an ordinary telegraph wire. The light and heat waves of the sun and stars travel to us through millions of miles of space, and sound also reaches our ears without requiring any artificial conductor. Is it not, therefore, wonderful that man should have devised means by which he is enabled to confine electricity conveying messages or power to a wire and cause the effect, which we call an electric current, to follow all the turns and convolutions which may exist in the wire?

We find that the first systems of telegraphy used by mankind were truly wireless. A bonfire built on a hill by a band of aboriginal Indians conveyed a signal wirelessly by etheric waves—in this case light waves—to Indians on another hill, perhaps miles distant. Even to-day there are innumerable systems of what may truly be called wireless telegraphy in practical use. A red light at a railway crossing conveys a signal by waves through the ether to the eye of the engine driver. The red light is the transmitter, the eye the receiver.

The method of space telegraphy, of which I intend speaking to-night, is founded on a comparatively new way of controlling and detecting certain kinds of etheric waves, much slower in rate of vibration than light waves, called Hertzian waves, after the scientist who first demonstrated their existence.

The mathematical and experimental proof by Clerk Maxwell and Heinrich Hertz of the identity of light and electricity, and the knowledge of how to produce and detect certain previously unknown ether waves, made possible this new method of communication.

I think I am right in saying that the importance of the discoveries of Maxwell and Hertz was realised by very few, and even perhaps so recently as a year ago, a great number of scientific men would have hardly foreseen the advances which have been made in so brief a time in the art of space telegraphy.

The time allowed for this discourse does not permit me to describe all the various steps which have made possible the results recently obtained, nor to describe the work of the numerous workers who have contributed to the advance of the subject, but I hope it may be of interest if I describe the various problems which have lately been solved, and the very interesting developments which have taken place in my own work during the last few months.

I shall first briefly describe my system as used in my early experiments six years ago, and afterwards endeavour to explain the various improvements and modifications which have since been introduced into it.

The transmitter consists of a modified form of Hertzian oscillator, the main feature of which is in having one sphere of the spark discharger earthed, and the other connected to an elevated capacity area or to a comparatively vertical wire. The two spheres are also connected to the ends of the secondary winding of an induction coil or transformer. When the key is pressed the current of the battery is allowed to actuate the spark coil, which charges the spheres and the vertical wire, which, when discharging, causes a rapid succession of sparks to pass across the spark gap.

The sudden release caused by the spark discharge of the electrical strain or displacement created along certain lines of electric force through space by the charged wire causes some of the electrical energy to be thrown off in the form of a displacement wave in the ether, and as a consequence the vertical wire becomes a radiator of electric waves.

In this connection it is interesting to remember that Lord Kelvin showed mathematically more than 40 years ago the precise conditions under which such a discharge as we are considering would be oscillatory.

It is easy to understand how by pressing the key for longer or shorter intervals it is possible to emit a long or short succession of impulses or waves which, when they influence a suitable receiver, reproduce on it a long or short effect according to their duration, in this way reproducing the Morse or other signals transmitted from the sending station.

The receiver consists of a coherer (on the nature of which I hope to make a few further remarks later) placed in a circuit containing a local cell and a sensitive telegraph relay actuating another circuit which works a trembler or decoherer and a recording instrument. In its normal condition the resistance of the coherer is infinite, or at least very great, and the current of the battery cannot pass through it to actuate the instruments, but when influenced by electric waves the coherer becomes a comparatively good conductor, its resistance falling to between 100 and 500 ohms. This allows the current from the local cell to actuate the relay, which in turn causes another stronger current to work the recording instrument and also the tapper or decoherer, which is so arranged as to tap or shake the coherer, and in this way restore its sensitiveness. The practical result is that the circuit of the recording instrument is closed for a time equal to that during which the key is pressed at the transmitting station, and in this way it is possible to obtain a graphic, acoustic, or optical reproduction of the movements of the key at the sending station. One end of the tube or coherer is connected to earth, and the other to an insulated conductor preferably terminating in a capacity area, similar in every respect to the one employed at the transmitting station.

* Discourse delivered at the Royal Institution, London, on Friday, June 13th, for a copy of which we are indebted to Marconi's Wireless Telegraph Company, Limited.

I noticed that by employing similar vertical rods at both stations it was possible to detect the effects of electric waves, and in that way convey the intelligible alphabetical signals over distances far greater than had previously been believed possible, and by means of similar arrangements distances of transmission up to about 100 miles were obtained.

It was soon, however, realised that so long as it was possible to work only two installations within what I may call their sphere of influence, a very important limit to the practical utilisation of the system was imposed.

Without some practical method of tuning the stations it would have been impossible to work a number in the vicinity of each other at the same time without interference caused by the mixing of messages.

The new method of connection which I adopted in 1898, *i.e.*, connecting the receiving vertical wire or aerial directly to earth instead of to the coherer, and the introduction of a proper form of oscillation transformer in conjunction with a condenser, so as to form a resonator tuned to respond best to waves given out by a given length of aerial wire, were important steps in the right direction. I referred at length to this improvement in the discourse which I had the honour to deliver at this table on February 2nd, 1900.

I had, however, realised at the time that one great difficulty in the way of achieving the desired effects was caused by the action of the transmitting wire. A straight rod in which electrical oscillations are set up forms, as is well known, a very good radiator of electrical waves.

In all what we call good radiators electrical oscillations set up by the ordinary spark discharge method cease or are damped out very rapidly, not necessarily by resistance, but by electrical radiation removing the energy in the form of electric waves.

It is a well-known fact that when one of two tuning forks having the same period of vibration is set in motion, waves will form in the air, and the other tuning fork, if in suitable proximity, will immediately begin to vibrate in unison with the first. In the same way, a violin player sounding a note on his instrument will find a response from a certain wire in a piano near by, that particular wire out of all the wires of the piano happening to be the only one which has a period of vibration identical with that of the musical note sounded by the violinist. Tuning forks and violins, of course, have to do with air waves, and wireless telegraphy with ether waves, but the action in both cases is similar.

It is very important to take into consideration the one essential condition which must be obtained in order that a well-marked tuning, or electrical resonance, may take place. Electrical resonance, like mechanical resonance, essentially depends upon the accumulated effect of a large number of small impulses properly timed. Tuning can only be obtained if a sufficient number of these timed electrical impulses reach the receiver. As Prof. Fleming so graphically puts it in one of his lectures on electrical oscillations, to "set a pendulum in vibration by puffs of air, we must not only time the puffs properly, but keep on puffing for a considerable period."

It is, therefore, clear that a dead-beat radiator—*i.e.*, one that does not give a train or succession of electrical oscillations—is not suitable for tuned or syntonic space telegraphy.

As I pointed out before, a transmitter consisting of a vertical wire discharging through a spark gap is not a persistent oscillator. Its electrical capacity is comparatively so small, and its capability of radiating waves so great, that the oscillations which take place in it must be considerably damped. In this case receivers or resonators of a considerably different period or pitch will respond and be affected by it.

Early in 1900 I obtained very good results with another arrangement, in which the radiating and resonating conductors each take the form of two concentric cylinders, the internal cylinder being earthed. By using zinc cylinders only 7 metres high and 1·5 metres in diameter, good signals could easily be obtained between St. Catherine's Point, Isle of Wight, and Poole, over a distance of 30 miles, these signals not being interfered with or read by other wireless telegraph installations worked by my assistants or by the Admiralty in the immediate vicinity.

The capacity of the transmitter due to the internal conductor is so large that the energy set in motion by the spark discharge cannot all radiate in one or two oscillations, but forms a train of slowly damped oscillations, which is just what is required.

A simple vertical wire may be compared with an empty teapot, which, after being heated, would cool very rapidly, and the concentric cylinder system with the same teapot filled with hot water which would take a very much longer time to cool.

In the receiver the closely adjacent cylinders, which give it large electrical capacity, cause it to be a resonator possessing a very decided period of its own, and it becomes no longer apt to respond to frequencies which differ from its own particular period of electrical oscillation, nor to be interfered with by stray ether waves which are sometimes caused by atmospheric disturbances, and which occasionally prove troublesome during the summer.

(To be continued.)

Coventry.—A L.G.B. inquiry was held last week into an application of the City Council to borrow a further sum of £20,480 for the electric light undertaking, and £2,000 for the purchase of electric motors to be hired out to manufacturers.

THE ADVANTAGES OF CONDENSING.

It is one of the more recent dogmas that there is but little if any advantage in using condensing engines when high boiler pressure is available. This fallacy has obtained quite a considerable sway of late years, especially in regard to electrical working. When boiler pressures were only 20 to 30 lbs., it is evident that even without any expansion whatever, an additional 15 lbs. due to condensing was a very substantial addition to the mean pressure available from an initial pressure in the boiler for the above small amounts. With boiler pressures of 150 lbs., a superficial thinker may, perhaps look upon an extra 15 lbs. as too trivial to take into account. Let the actual facts of practice be considered, however. A modern engine too frequently has the fault that it does not get anything like full boiler pressure upon the piston unless at full load.

An ordinary compound engine at 75 per cent. of its normal load will show a mean pressure referred to the L.P. cylinder of perhaps 30 lbs. If the engine is of small size, it will be running on an average load of not more than half the normal rating, with a mean cylinder pressure of about 20 lbs. Under circumstances of this kind the power given by condensing working is relatively very large, and it cannot be urged with any show of reason that a traction load can be run economically by a high pressure engine, *i.e.*, non-condensing. The error has arisen, in all probability, as the outcome of earlier days of electrical working, when lighting only was undertaken. The maximum peak of a lighting load is of very short duration, and it can be got over by running a cheap and uneconomical engine for a very small part of the time. In such a case a certain amount of reason can be advanced against the use of expensive plant to get over a peak of short duration. But a traction load bears no resemblance whatever to a lighting load. Its peaks occur every few minutes or every few seconds. It is impossible to put on and take off an engine to suit the momentary fluctuations. The same engine must run, at one moment carrying a load of 150 per cent. of normal, the next carrying but 30 per cent. of normal.

Without a battery to equalise the load on the engine, it is simply out of the question to expect economy from an engine so loaded, but there is no reason whatever for employing a larger non-condensing engine, when one of two-thirds the size, or even less, will turn the same load when condensing.

The economical load of a factory engine asks for 40 or 45 lbs. mean cylinder pressure. When only 25 or 30 lbs. can be secured it is impossible to have economy, not only because the engine frictional loss is great in proportion to the useful load, but because all other losses are increased, notably, those due to cylinder condensation.

The effect of a battery and reversible booster is to enable an engine to run at a higher mean cylinder pressure, for the necessity is abolished of coping with maximum load peaks by the unaided engine. Without a battery the one engine has to be aided by a second engine. The economy of a battery comes in the abolition of the second engine with its duplication of losses. There is no economy to compare with condensing when applied to a traction plant, unless it be the battery which equalises the engine load. Unfortunately, it is only too common to find the benefits of condensation thrown away to a very considerable extent.

A temperature of even 126° only represents about 2 lbs. absolute pressure. A temperature of 100° represents about 1 lb. pressure. Yet how often do we see a condenser discharging at 100° and showing 13·7 vacuum, or 27½ in.? There is no reason but one why the vacuum does not agree with the temperature. That one reason in a well proportioned plant is air. Where water is used over and over again for feed and for injection there is very little dissolved air remaining in it Evidently, then, the air pumped out by the air pump does not enter with the feed or the injection. In a surface condenser there is no injection water, and the feed goes round and round purged of the last atom of air. Where, then, does the air come from that is constantly discharged from the air pump? Leakage alone accounts for it. Leakage occurs at glands and at joints. The glands which leak are those of the L.P. piston and valve rods. Modern high steam pressure, with its high temperatures and superheat, calls for special packings, but it is often overlooked that the high temperature does not obtain as regards the L.P. rods, and these may still be packed with soft packings with advantage.

Air will leak in at pipe joints, through many unconsidered porosities and at badly ground valves and cocks. Another flagrant offender is the atmospheric exhaust valve. When shut this valve presents a large periphery for leakage; provision ought to be made to keep a water seal over this, and there ought to be a glass water gauge to show the presence of the water seal and indicate its too rapid disappearance. This water seal ought to be filled with the feed make up. A slight leak will do no harm, but it should not exceed the amount necessary to keep up the feed. Attention to air leakages will always pay. When the stop valve of an engine is shut and the engine stopped and waste cocks closed the vacuum should read 12 lbs. after an hour's stoppage. This has been done, and may be done again. It is a possibility that should be aimed at. If secured it would enable the air pump to be reduced in speed down to very little more than necessary to remove the water.

This is at once both the fault and the virtue of the independent condensing plant. It can be run at the speed necessary. Unfortunately the power to run the air pump fast helps to cover the faults of air leakage. An air pump that runs with the engine, stroke per stroke, and that has once been sufficient, will show, when it fails to give a proper vacuum, that there must be some air leak or other fault at work. But a pump that can be run quickly

enough to maintain a good vacuum in spite of leaks is a consumer of unnecessary steam, and does not demand the attention that a failing vacuum asks from an engineer who appreciates vacuum and is dissatisfied when he does not get 27 in.

W. H. B.

THE ARBITRATION BETWEEN THE METROPOLITAN ELECTRIC SUPPLY COMPANY AND THE MARYLEBONE BOROUGH COUNCIL.

Further sittings of the tribunal appointed to arbitrate in the question of the sale of the above company have been held at the Surveyor's Institute, Westminster.

Mr. Fletcher Moulton, K.C., who represents the Marylebone Borough Council, contended that the most important point of their case was to see what the burdens of the undertaking were. They were to buy it with all its burdens. The company could not say: "We have a right to charge you according to the profits made," if they saw that those profits were made by disregarding their contractural obligations, and where there was a contract with nothing but a variation in price, *prima facie* everybody was entitled to that, and surely they were entitled to see it.

Mr. Russell, K.C., the Umpire, said that all they had to do was to arrive at the right sum to be paid by the Borough Council for the purchase of the undertaking.

Mr. Moulton replied that that was so, but the company was putting forward evidence of actual price on which to base their estimate of profit, and if the price charged was not the price authorised to be charged, he claimed that he was entitled to attack their tables on that ground.

The Umpire said that he and his colleagues were of opinion that Mr. Moulton had not made out any case for going into circumstances in areas other than Marylebone of the charges below the ordinary charge of 6d. per Board of Trade unit. He did not in the least intend to exclude any observations which might arise when they had got before them the figure which had been promised of what was the actual price in other areas, or any observations that counsel might make as to the contrast between the average price of other areas and the average price in Marylebone—it was only in regard to the circumstances of individual cases that they expressed the opinion that he was not entitled to go into that.

Mr. Cripps, K.C., said that up to the present nothing had been shown in the case, and no argument had been addressed by Mr. Moulton, which entitled him to look to the form of special contracts outside the Marylebone area. On behalf of the Metropolitan Company, he was there to say that if at any time any further investigation, outside Marylebone, of the charges would assist the inquiry, they put themselves in the hands of the Court, and would give every possible assistance on every possible point, but it was ridiculous to suggest that there was any hard and fast ruling on the subject. He objected to a sort of fishing inquiry to go into special contracts with particular customers, all of whom would much object to its being gone into.

Mr. Moulton said that all he at present asked for was to see the contracts. They discovered a large number of cases of supply at lower prices than the supply in corresponding circumstances in Marylebone, as far as they could tell. All he asked for now was to see the contracts under which these low prices were charged in mid-London, as compared with Marylebone.

Eventually it was agreed that the accountants of the company and of the Borough Council should meet to inspect the contracts, on the understanding that the inspection should be private, and that they should tabulate the results in such a form as they thought most convenient.

The cross-examination of Mr. Conacher was then continued. On the question of capital, Witness said he did not think there would be any difficulty in inducing people to come in with capital sufficient to keep up the business. Their estimate for capital, and the price for raising it, depended to some extent upon their keeping up the price at which they sold their electricity. The average price of supply last year in mid-London was 4·40d. and in St. Martin's 4·45d. prepared in the same way as the average of 5·24d. for Marylebone.

Mr. Moulton: Therefore you think practically you will be allowed to maintain until 1903 the price to which you have already got in mid-London to-day?—Yes, having regard to the circumstances of Marylebone.

I do not know what you mean by the circumstances of Marylebone—do you call Marylebone a good area or not?—Yes, very good. It is a different kind from mid-London, and I cannot express that better in a general way than by pointing out that, taking the number of units sold per consumer and starting with Marylebone as a basis, we sell 30 per cent. more per consumer in mid-London and 50 per cent. more per consumer in St. Martin's.

That does not make it the least bit more profitable—it is only a question of where you have fewer consumers?—No; it indicates that there are more business consumers. There are very large consumers in theatres and music halls; there are large consumers in business who use their lamps during the day in basements and in the hours of night when the ordinary load goes off. There is, for instance, the Law Courts; a very large consumer, and the effect of such a consumer upon the average is seen at once when one contrasts what we sell for such Courts as exist in Marylebone at the rate of 4d. with what we sell for the Royal Courts of Justice also at the rate of 4d., and there is a large proportion of consumers of this class of greater magnitude, and the average is very much diminished. Continuing, the witness said that on the point of competition affecting their profits, should they bear in mind that in Marylebone there was no competition and could not be competition for some years to come, and if anybody were to come in he doubted if, in an area like Marylebone, they could live on the capital that they would have to put in.

Mr. Moulton: May I put it that in electric lighting there is no goodwill; the power of switching over is perfectly simple, and if there are two series of mains laid, the two companies are obliged to charge equal prices?—If there is a goodwill in a shop which may be opposed by a shop next door, there is more in electric light supply.

I mean a new company coming in and putting its mains in a street, is in as good a position as the old?—If the company is in a position to take customers.

And the two companies must have the same rates?—Very likely, but not necessarily.

If there is any difference, the one which is the lowest would have it?—In ordinary circumstances that would be so.

Take the case of a new company coming in; it would have the advantage of quite new plant?—Most of our plant is new. Witness, continuing, said they had estimated their net profit for 1904 on a 3½ per cent. table, but in doing so they did not admit the possibility of competition. He wished to be perfectly frank and say that in estimating the security of their profits, they did so on the assumption that they possessed a monopoly. The total capital now invested in the company was £500,000. They were claiming £2,771,938 after the severance.

Mr. Moulton: Not bad business for a £500,000 investment.

Mr. Conacher: But you must remember at what an early stage in this new enterprise the purchase has been forced upon us.

Mr. Moulton: But it is not a bad present value?—All the capital might have been lost; it was exceedingly doubtful if the enterprise would succeed, and as a matter of fact the shareholders had no return for some years; their shares were below par. We have built up the business. The shares, continued witness, were now £17 in the market. They were £10 shares, and had been as high as £22. They went down very much when the Vestry's Bill was before Parliament, and they began to go up when the agreement was made to sell. They were altering their system at Willesden, and intended to generate direct at 10,000 volts instead of generating at 500 and raising the voltage before transmission to 10,000

Mr. James Swinburne, examined by Mr. Cripps, said he was a consulting engineer, and for 10 years had done nothing but electrical work. He had made himself acquainted with the special conditions in Marylebone, as well as bringing to bear his general experience, and his view was that the company had hardly begun. It was quite a small thing to what it would be if left to develop. As regarded the probable future of the company in connection with lighting, he thought it would go on taking consumers for the next 30 years at a rate that would amount to 70 per cent. of the possible consumers at the end of that time. If those consumers took the same amount each as they did at the present time on the average, that would bring the lighting up to 13,000,000 units a year at the end of 30 years. As a matter of fact, he did not think there was the least chance of the consumers going on taking the same amount, they were pretty certain to increase, and it was difficult to say how far that increase might go. He should say that the domestic use, apart from motor use, would make it something like double. He did not think it was out of the way to estimate somewhere in the neighbourhood of 30,000,000 units for lighting, but it was exceedingly difficult to say; there was so little to go on. It was equally likely to go a great deal higher. As to the expectation in the future for motor power, he did not agree with Mr. Conacher; he thought his estimate was very much too low. He thought that the motor units would represent considerably more than the lighting at the end of 30 years. In Germany, already in many cases the motor was as big as the lighting. Anybody who had followed carefully the development of the motor industry must have noticed that the first tendency in automobiles had been to develop the petroleum automobiles which people went about the country at illegal speeds on; in towns there was a tendency to have something more convenient, and in America there was a proportion of two to one of electric vehicles to petroleum vehicles. In London the tendency would be to give up horses. It was getting very much that way now, and for town work there was no doubt that the electrical vehicle was infinitely more convenient than the petroleum. A comparatively small increase of electrical motor vehicles meant an enormous consumption of electrical energy. He also reckoned that electricity in the future would be largely used for heating. Then a great deal of domestic work would be done by the help of electrical power, such as carpet sweeping, &c, and another appliance was a small motor affair for keeping meat and other things cool—a tiny engine to save the ice bill. In making his estimate, he had assumed that people would probably double their consumption for house lighting.

As regards street lighting you look for an improvement?

Witness: Yes. Street lighting is hardly done electrically now, and the difficulty is that there is no satisfactory lamp—the incandescent lamp is too small and the arc lamp too large. There is the Nernst lamp, brought out recently, which is specially adapted for intermediate sizes. It can be made for big differences of pressure of 500 volts, and it can be made for 100 candles very easily, and then the lamps are specially designed for street lighting, and they work with very high efficiency; they only take a half or one-third of the power of the ordinary lamp, and we expect they will come in very largely and there will be a big demand for street lighting.

Continuing, witness said he did not know why it was that we had not so many electrical motors in this country as abroad, but the fact that they were taken up in Germany showed that probably they would be taken up in England eventually. The price in Germany for motor power varied from 2·4d. to 7d. per unit, with an average of 3½d.

Mr. Reginald R. Todd, engineer to the Metropolitan Electric Company, gave evidence as to the economies which the company expected to make at their generating stations. He said that the detartarisers had not been working sufficiently long to arrive at the actual result of the saving, which was put down at 10 per cent. on the coal bill. So far as they had at present gone, he could show a saving of a little over 6 per cent. There would also be a saving of 4 per cent. on the coal consumption by the use of Mason & Scott's water softening apparatus, which would prevent the boilers getting coated with the heavy lime deposit as they used to. The water softener would have the effect of taking out the lime which, when left in the boiler, was a very bad conductor of heat.

Cross-examined by Mr. Fletcher Moulton, Witness said that experience had shown that by a little extra capital expenditure the company would be able in the future to save a large sum in working expenses. They could not possibly have laid down a low tension system in the early days of the company on account of the capital cost, and the reason they originally used house transformers was to keep down the capital expenditure.

Lieut.-Colonel R. E. Crompton, examined by Mr. Cripps, said he was a past-president of the Institution of Electrical Engineers, and had had a number of years' experience in the designing and management of electric supply stations in London and elsewhere. He had made a special study of the working cost of electrical supply. Speaking generally, he agreed with the evidence of Mr. Conacher. He thought that that gentleman's estimate as to the increase of the company's business could very easily be upheld if they took the total of the units sold in the years from 1901—1931. Personally, he believed that 25 million units would be eventually arrived at by the year 1931. He believed that the increases would occur earlier than anticipated by Mr. Conacher, as he thought that the district had arrears to make up. It had not progressed at so rapid a rate as corresponding districts in other parts of London, but now that new methods of distribution and improved machinery were being put down, and now that the company were able to tackle the demand on them much more easily than they were able to do in the past, the scale of increase ought, in the nature of things, to be at a more rapid rate than in the corresponding districts in London which had been supplied with more modern machinery. By "corresponding districts" he meant districts like Westminster and Charing Cross. As regarded the estimated figures for lighting power given by Mr. Conacher, in his opinion they were wholly under-estimated. He should say that they would amount to three times the figure given by Mr. Conacher. He should expect that quite as large an amount would be sold in 1931 for power and similar purposes—low-priced uses of electricity—as would be sold for lighting at the higher price, and that if 25 millions were sold for lighting, then there would be fully 25 millions for power. His attention had been particularly directed, during the last few years, to that matter, and he believed that the prosperity of the various electrical undertakings would chiefly depend upon the development of that cheap-priced demand for power and heating. There were several reasons why it had not developed adequately up to the present time. For instance, it was only within the present year or so that the development of the manufacture of small motors had gone to such an extent, that their prices had been reduced so that they could be bought over the counter in an ironmonger's shop, so that the average householder could easily get hold of them at a moderate price. Another reason was, that up to the present all houses had been wired with a single circuit, and on a single circuit it had not been easy, up to the present, to give two prices for an electrical supply, and for that reason anybody who used motors or heating devices, or anything of that kind which took a great quantity of electricity, and who therefore required it at a lower price, had perforce to use them on the lighting circuits, and had to pay the full lighting rate. That had been a very great deterrent. A man found that when he had a motor for an hour or two working on his lighting circuit, it made such a notable increase in his lighting bill, that he said he would not have any more of it. It was the same with the heater—so long as a householder had to pay 6d. a unit for it he would not warm up a bedroom for his guest with the electric radiator put on to the lighting circuit; he preferred to use a gas stove. Then, again, the use of lifts was being greatly extended. He believed it was definitely proved that the only competitor to the electric lift was the hydraulic lift, and when the two were put in comparison, as had frequently been the case, the electric lift had been found to be cheaper. Another use which was coming slowly but surely was the use of an electric motor to drive refrigerating apparatus. As to the motor carriage demand, he thought that was likely to be so great that it was difficult to appreciate it at present. A year or two ago there were only a few experimental electrical vehicles on the streets, but the demand was increasing at such a rate that there would be many thousands of these vehicles in the streets of London within two or three years' time. Taking it that they were supplying electricity for motor purposes at 2d., the charge only came out at 13s. 4d. a week, which was much less than the cost of feeding a single horse. They thought that at present the most convenient thing would be for a company like the Metropolitan to supply charging centres in mews opposite a certain number of coach houses, where they now kept their carriages, and in that way their carriages could be charged at home, and what was more, charged at night, which was a very important thing to a company in view of improving the load factor. If only about 5 per cent. of the inhabitants of Marylebone had the cars, their output for motor power purposes would be brought up to 30 millions. That was the kind of thing that was going on in New York now. Up to the present the company had not been laying itself out for purposes other than lighting, but it had been gradually getting its equipment and putting itself in a position to supply, and he should say that by 1931 the amount supplied for motor power would be as important as that supplied for lighting. As an electrical expert, he felt pretty certain that his prophecy would be realised. He considered that the estimates of Mr. Conacher as to the probable working expenses of the company in the future were too high, and that the same results could be obtained at a lower cost. The getting rid of house transformers would be a great saving. The load factor, as compared with the output, was a very material factor in the cost, and the more they could spread the user of electricity over the 24 hours the better the load factor. Experience had shown them that they tempted more custom and got more out of it by reducing their price, and that in the end they made more money for their shareholders. The average price obtained last year in Kensington and Knightsbridge was 4·65d.

Cross-examined by Lord Robert Cecil, Witness said his own impression was that the electric motor would beat either steam or petrol-driven vehicles. At present the steam motor was cheaper than the electrical one, but the price of the latter was now coming down so rapidly that he thought it would hold the field. He was perfectly certain that electric motors on the streets were going to be a great feature of London in a very few years' time. He did not mind stating so in that room, and it would be recorded against him, and a few years hence he would be very proud to be reminded of what he had said. As to lighting, he believed that at the end of 1931 90 per cent. of the houses in Marylebone would be taking an electrical supply. The inquiry was again adjourned.

REVIEWS.

Transport de l'Energie à Grandes Distances par l'Electricité. By F. Loppe. Paris: E. Bernard & Co.

This is a brochure of about 115 pages consisting mainly of descriptions of long-distance power transmission plants, and of machinery and apparatus connected therewith; it is apparently based upon work carried out by, and plant and material exhibited by, a number of firms at the Paris Exhibition, 1900.

Starting with brief descriptions of the various systems of power transmission actually employed at the present day, including the direct-current series system, the author next considers the question of the design and construction of the transmission line in some detail. But insomuch as long distances only are in question, involving the employment of pressures of 10,000 volts or more, the author confines himself to the question of overhead lines, because the bulk of the work hitherto carried out (at any rate on the Continent and in America) has been with bare conductors carried on poles, and guarded or not, according to circumstances and the locality.

The author first refers to the so-called "skin effect" which must be taken into account when dealing with heavy conductors (especially if the frequency is 50 cycles or more), giving in this connection Hospitalier's useful tables of correcting factors; afterwards he discusses the question of the impedance of overhead lines with alternating currents, with the help of tables of constants given by Blondel some years ago. These line constants have proved to be of considerable service in actual practice, as they take into account not only the inductance of the individual line wires (depending upon the diameter of the conductors employed), but also the effect of the mutual inductance between neighbouring wires (depending upon the spacing); it must be noted, however, that they are more suited to the requirements of the single or two-phase case than for the case of three-phase systems, as the relative arrangement of the three conductors upon the poles plays an important part here, which the factors in question do not take into account.

The author briefly discusses the question of the capacity of overhead lines and (in conjunction with the tables referred to above) that of the period of resonance of such circuits; this matter becomes of considerable importance when dealing with very long transmissions, and the author might well have considered it at greater length. He passes on, however, to a comparison of the relative weights of copper required for different systems of transmission, in which we find nothing new, and then gives a *résumé* of Mr. Scott's experiments at Telluride in 1897, regarding the

losses which occur in very high pressure overhead lines on account of static discharges. For a given length of line and pressure, these losses were shown to be nearly independent of the frequency, but to be greatly dependent upon the wave shape and the diameter of conductor, sinusoidal pressure waves and large diameters tending to minimise the losses.

The actual construction of overhead power lines is next considered; the questions of poles, insulators, guard wires and lightning arresters are discussed in a practical manner, but much more could have been said with advantage on such a subject. The leading features are, however, well brought out, and form interesting reading.

The direct current series system (as worked out by Mr. Thury) is considered at some length, together with the various details belonging to it, such as the regulators for the generators and motors, and the controlling gear for them; the author here follows very closely the printed brochure which Mr. Thury placed at the disposal of visitors to the Exhibition. One cannot help being struck with the vast amount of ingenuity displayed by him in getting over the numerous difficulties incidental to such a system, as well as with his courage in striving to make a commercial success of a method of working which is practically impossible.

A short description is next given of various types of high pressure switches and fuses, mostly of Continental origin. This is followed by descriptions of high pressure generating and sub-station switchboards standard with certain Continental firms. The arrangement of the Bertram high pressure boards and gear is especially noteworthy. This part of the treatise concludes with a note on the regulation of secondary (alternating current) networks.

The remainder of the brochure is taken up with descriptions of typical long-distance power transmission plants. These include that of Chaux-de-Fond Locle (Thury system, 14,000 volts), Gréswaudan (single-phase at 12,000 volts), Weisloch (single-phase at 10,000 volts), Witwatersrand (three-phase at 10,000 volts), Saint-Georges (three-phase at 8,000 volts), &c. Finally some particulars are given, in tabular form, of most of the installations in the world working at pressures of 10,000 volts or more. It is worthy of note that no mention is made of the Deptford station in London, which was, of course, the pioneer in this class of work; moreover, the three English installations mentioned have all been equipped by foreign firms.

In conclusion, we may say that Mr. Loppe's brochure forms an interesting and sufficiently accurate summary of the present state of long-distance ower transmission, and of matters connected with the subject. It is certainly worthy of something better than a paper cover, and would have been improved by better illustrations and by more detailed treatment of certain portions.

The Factory and Workshop Act, 1901: Its general effect and Parliamentary History (including the full text of the Act), for the guidance of employers of labour and others. By C. W. WILLIAMS, B.A., Barrister-at-Law, and CHARLES E. MUSGRAVE, assistant secretary to the London Chamber of Commerce. London: Effingham Wilson. 196 pages. Price 3s. 6d.

This work is one of many which have appeared since the passing of the Factory and Workshop Act, 1901. It is stated in the preface that "any guide to an Act which came into operation on January 1st, 1902, must at present be necessarily incomplete" . . . . and that "the authors do not claim to have produced a complete text-book of the Act. Their design is to show in simple language its effect as a whole, the principal changes that have been made in the law, and the manner in which the measure passed through Parliament. They appeal to the consideration of laymen rather than lawyers; to those who are subject to the law rather than to its administrators; to practical everyday readers rather than to political economists." Bearing these modest pretensions carefully in mind, the work before us seems to be well suited to its purpose.

Part I. deals generally with the effect of the Act. In Part II. we find a useful sketch of the changes which have been made in the law by the new Act. We observe that the provision which now requires fire escapes on and below, as well as above the ground floor has been duly noted—a point which has escaped certain other text-book writers on the Act. The authors have also noted that electrical stations now come within the Act.

Part III., which gives the Parliamentary history of the Act, may be very interesting, but we doubt whether it will be of much use to those for whom the work is intended.

The remainder of the work is devoted to the text of the Act, with explanatory notes; an appendix relating to orders and special rules; education; special exceptions, and dangerous trades. A good index concludes the work.

We cannot say much for the printing of the book. Having regard to the price, it compares unfavourably in this respect with treatises upon the same subject which we have had an opportunity of considering. Such criticism, however, is not likely to affect the minds of those who desire to have a concise treatise upon the Factory Acts upon their bookshelf.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1900.

7,200. "Improvements in electric belts for the electric treatment of the human body." W. P. Thompson. (M. A. McLaughlin). Dated April 18th, 1900. Relates to an electric belt and suspensory appliances having means for producing and regulating the strength of electrification. It consists of a belt fitted with a battery, rheostat and electrodes, and having attached to it a suspensory appliance provided with an electrode. The battery consists of a series of cells, each comprising an inner copper plate formed with links and surrounded by absorbent material saturated with acid, and enclosed between zinc plates soldered to a casing connected to the links of the next cell. The rheostat comprises an insulating plate secured by rivets to the belt, and provided with a pivoted arm connected by a wire with the electrodes, and adapted to engage a series of studs inserted in an arc of carbon or other resistance. The end stud is connected to the battery by a ring. The electrodes consist of curved plates padded with moistened felt provided with cotton or other covers, and formed with perforated plates at the back, which slide on webbing or on elastic fabric secured by hooks to the rheostat. The wires are connected to the plates. 3 claims.

7,272. "Improved connections for carbon electrodes." H. Baker. Dated April 18th, 1900. Carbon electrodes are passed through the top or side of the cell, and their projecting ends are connected in pairs by two rigid contact plates having a bolt and a tightening nut. The several pairs of electrodes are connected up in parallel by the copper band, which is secured by the nut, or by the second nut on the same bolt above the nut. 1 claim.

7,210. "Improvements in osmium illuminating filaments." C. A. von Welsbach. Dated April 18th, 1900. Relates to incandescence lamps—filaments containing osmium as described in Specifications Nos. 1,535 and 13,116, A.D. 1898, formed into coils consisting of numerous turns of small diameter, which may be flattened. Slight contact between adjacent is not important. 3 claims.

7,285. "Improvements in or relating to electric railways operated on the conduit system." R. C. Parsons, R. Belfield and W. Chapman. Dated April 19th, 1900. Projecting ribs are variously disposed on yokes to strengthen them at the centre and the slot rails are tied to the rails and to projections on the yoke by tie-bars. Yokes which form the conduit and do not support the rails, are also made with the ribs. Boxes with removable covers and supporting flanges are bolted in recesses on the sides of the yoke, or are made integral therewith. Brackets or shelves inside the boxes support the insulators which carry the L-shaped arms on which the conductors are mounted. A cap bolted to the bracket or shelf covers the insulator and the nut which secures the arm. 7 claims.

7,287. "Improvements in electric railways with underground conductors." L. Nonne and G. Schonfelder. Dated April 19th, 1900. Electric railways and tramways on a road contact system with switches operated mechanically, supplemented by electro-magnetic arrangements in some instances. 3 claims.

7,255. "Improvements in microphones." J. Carpaux. Dated April 20th, 1900. Microphones are constructed with the carbon granules held in shouldered or cylindrical holes or recesses in a metal block. The block is preferably silver-plated copper, and is secured to the case by a screw metal backing plate, the screw being insulated by an ebonite bush. The carbon diaphragm gripped between the front and back portions of the metal case forms a protective gauze screen. 8 claims.

7,356. "Improvements in electrical incandescence lamps." E. Schattner and T. W. Harmer. Dated April 20th, 1900. Preliminary heating of a magnesia or other refractory incandescence rod is effected by a parallel rod of carbon or other conducting material, the supply of current to the heater being cut off, when the magnesia rod has become hot by thermal expansion either of the magnesia rod, which moves a contact spring, carried by a glass or other insulating support, and a metal strip, or of a coiled strip of metal or other material which has a contact arm. 5 claims.

7,372. "An improved manufacture of electrodes for secondary batteries." A. Tribelhorn. Dated April 20th, 1900. Relates to the cup-shaped electrodes described in Specification No. 26,680, A.D. 1897, and consists in making large square electrodes of this design by building them up of four separate pieces or of two pieces. They are united together by tenons and mortices or other suitable means, and by soldering, rods serve to support the electrodes one above the other. 2 claims.

7,373. "Improvements in the formation of drum windings for dynamo-electric machines." W. Langdon Davies and A. Soames. Dated April 20th, 1900. Relates to the formation of drum windings for dynamo-electric machines. A coil is first produced by winding on a two-part mould, or by squeezing a circular coil into shape by external lateral pressure and internal longitudinal stretching. Grooves enable the coil to be temporarily bound by strings or clamps. After the coil has been insulated and taped, it is bent to the required form. A wedge holds one of the parallel sides in a slot, and the sliding block carries the other with it. The coil is adapted for a multipolar machine. The parallel portions lie in grooves in the armature, and the outer proportions constitute the end connections. The portions may be further shaped on a cylindrical mould block, slotted like the armature. 2 claims.

7,392. "Improvements in electro-motors of optional speed." A. Lehner and A. von Datiber. Dated April 21st, 1900. An electric motor is constructed of one or more pairs of electro-magnets with inclined polar surfaces, between which is arranged a pivoted soft iron armature, to which an oscillatory movement of small amplitude is imparted by alternately exciting the electro-magnets. This oscillatory movement is converted into a rotary movement by means of a two-armed lever, connected by links to a shorter two-armed lever, from which the motion is transmitted by a lever and connecting rod to a crank on the shaft to be rotated. The magnets are excited alternately by means of a commutator on the rotating shaft. 3 claims.

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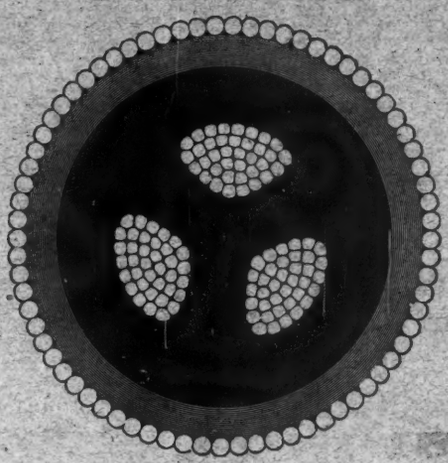
T  T

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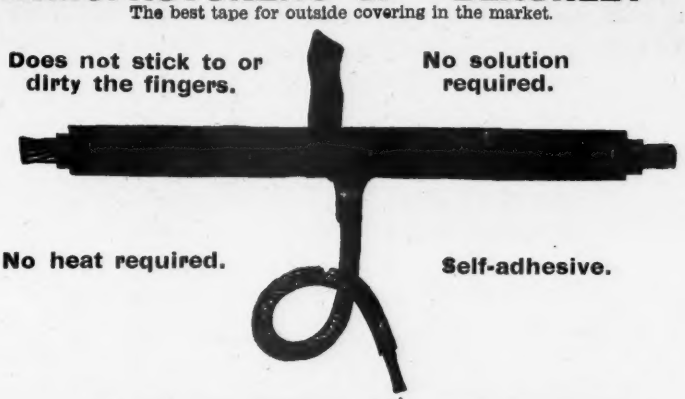

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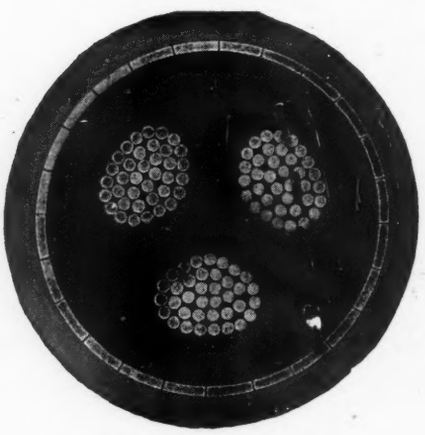

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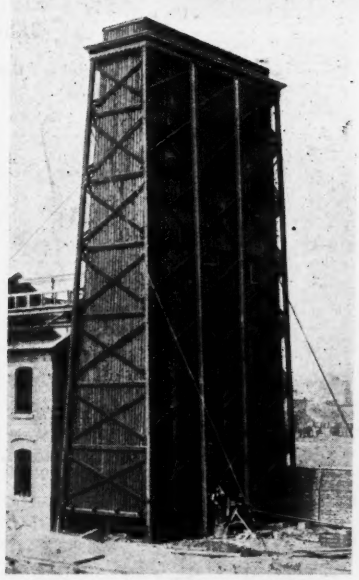

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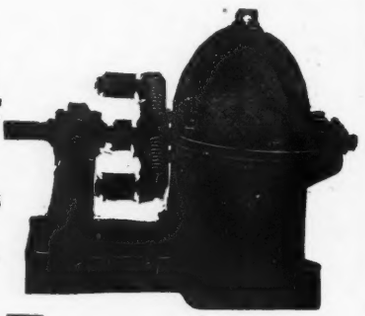

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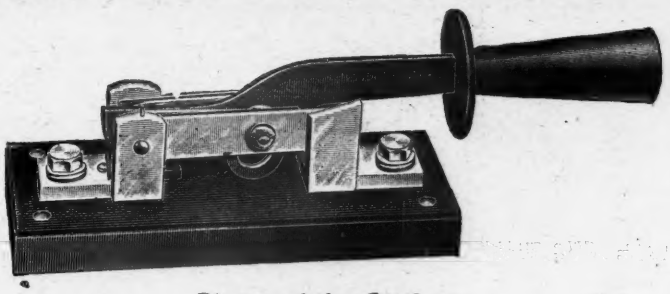

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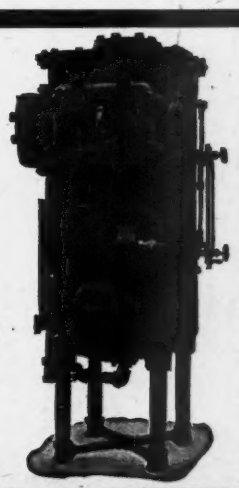

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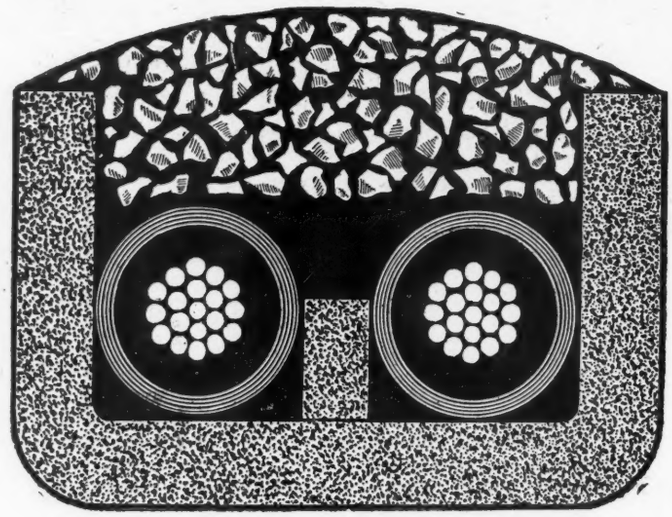

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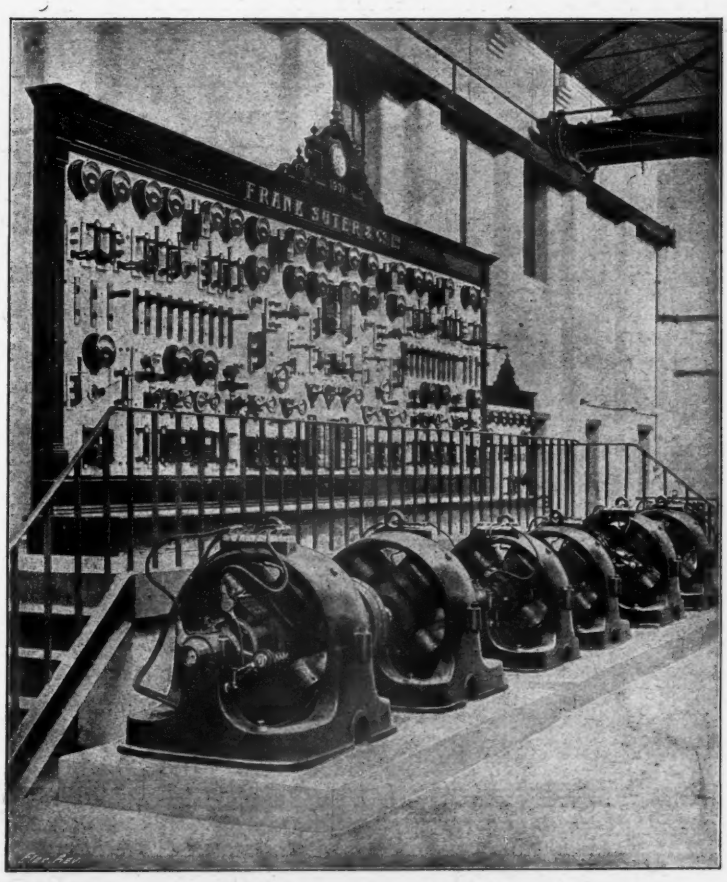

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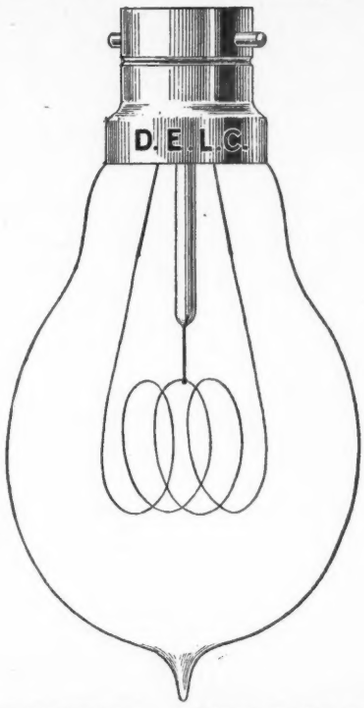

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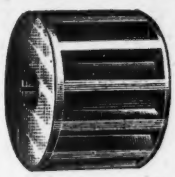

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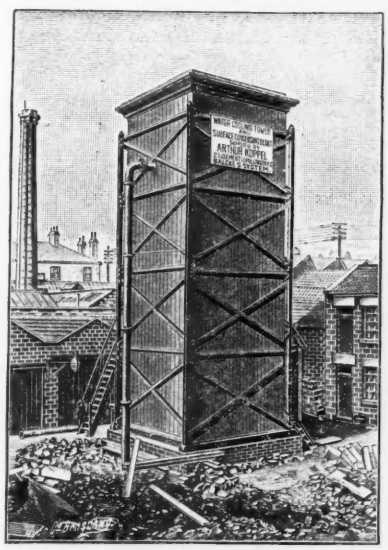

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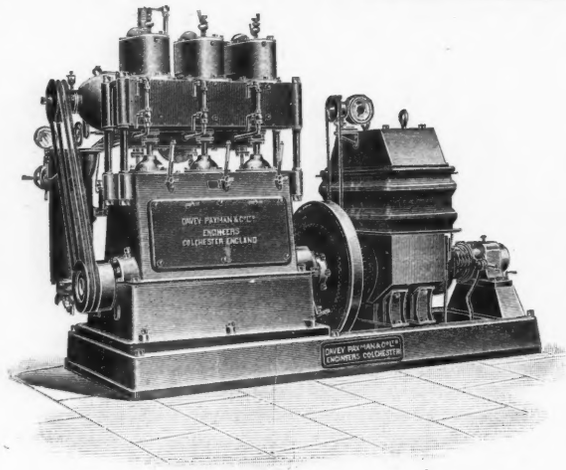

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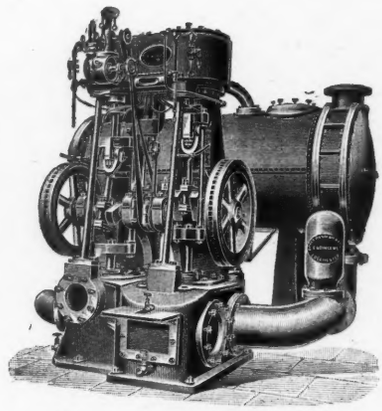

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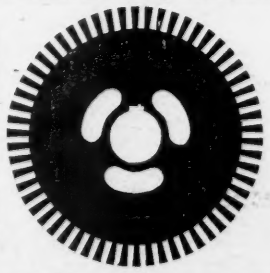

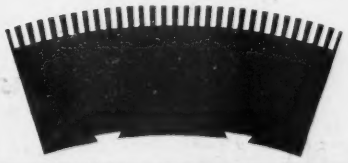

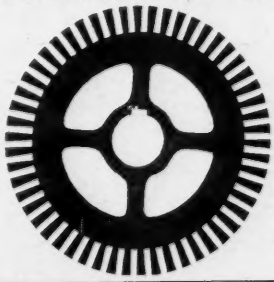

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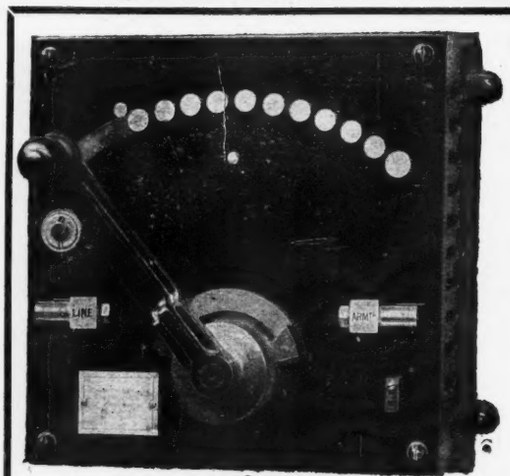

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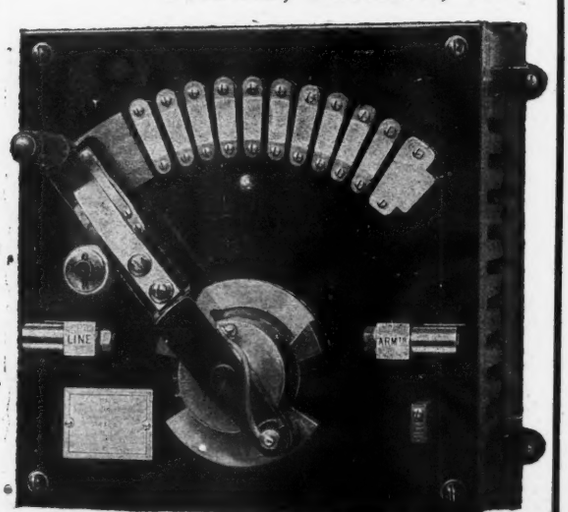

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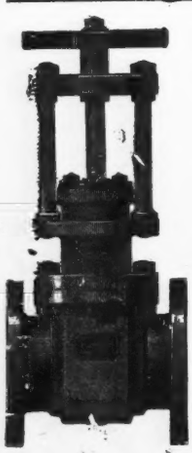

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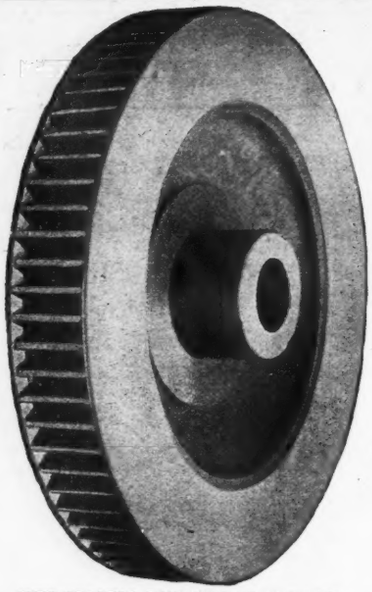

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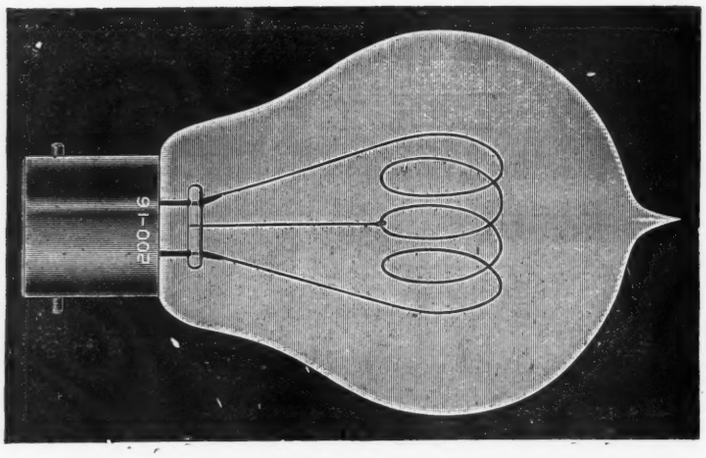

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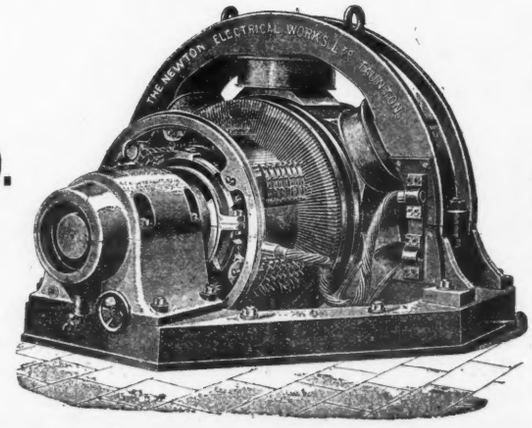

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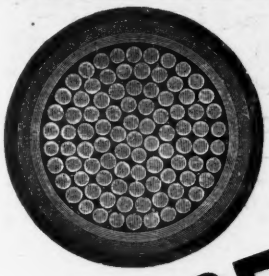

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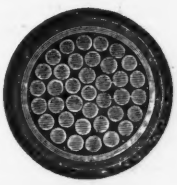

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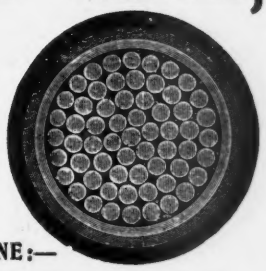

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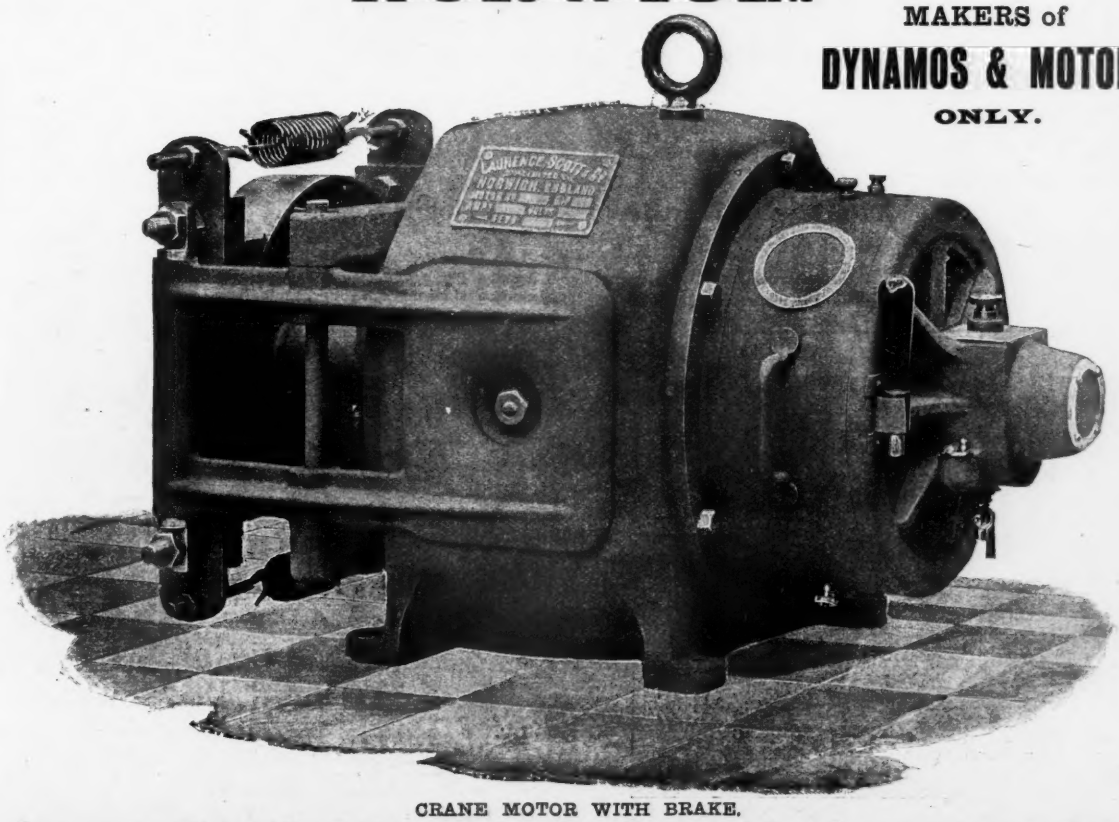

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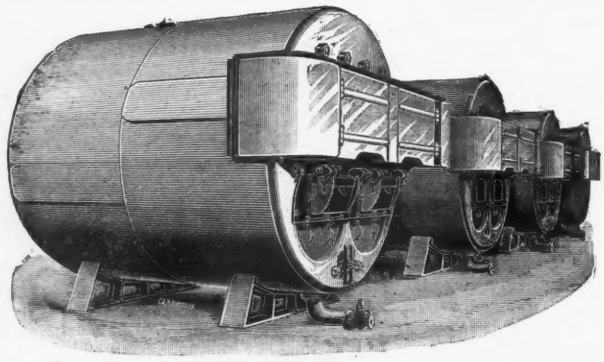

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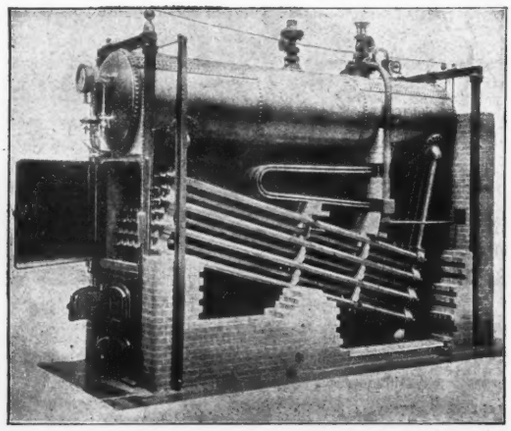

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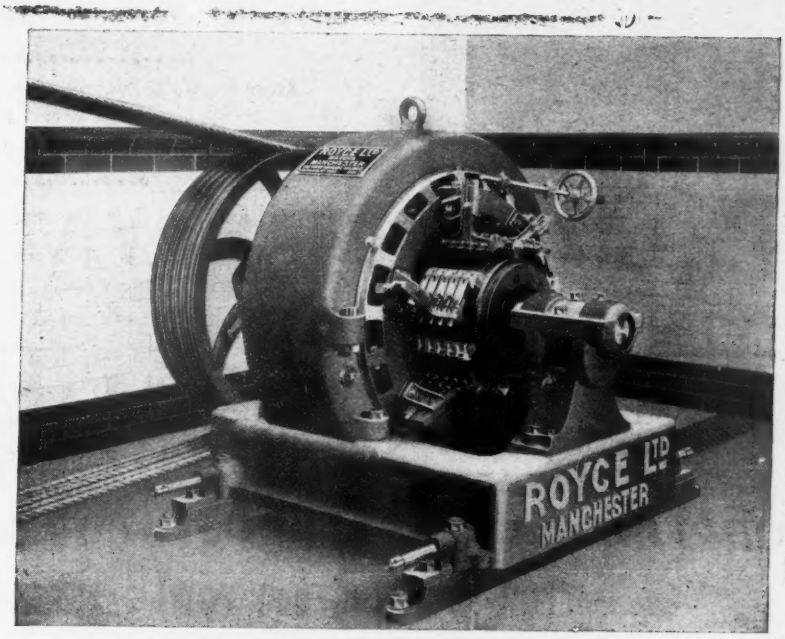

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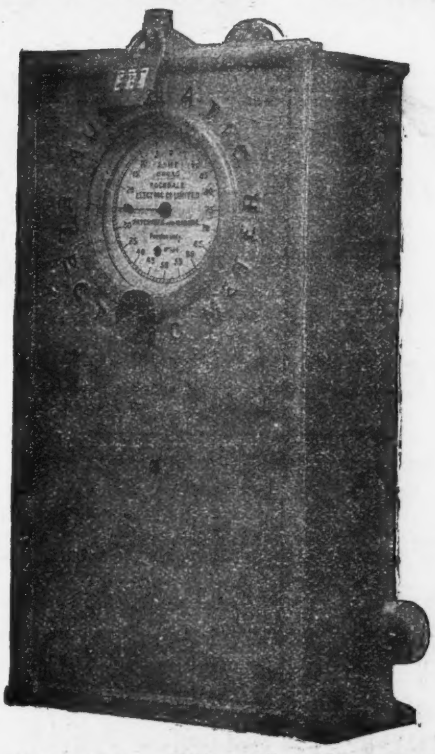

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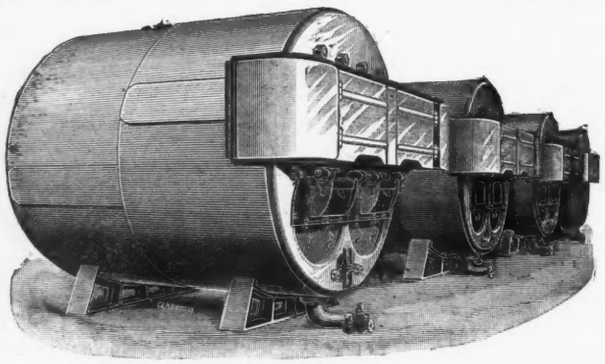

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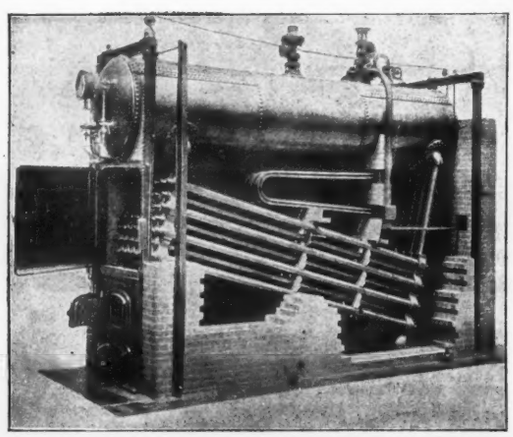

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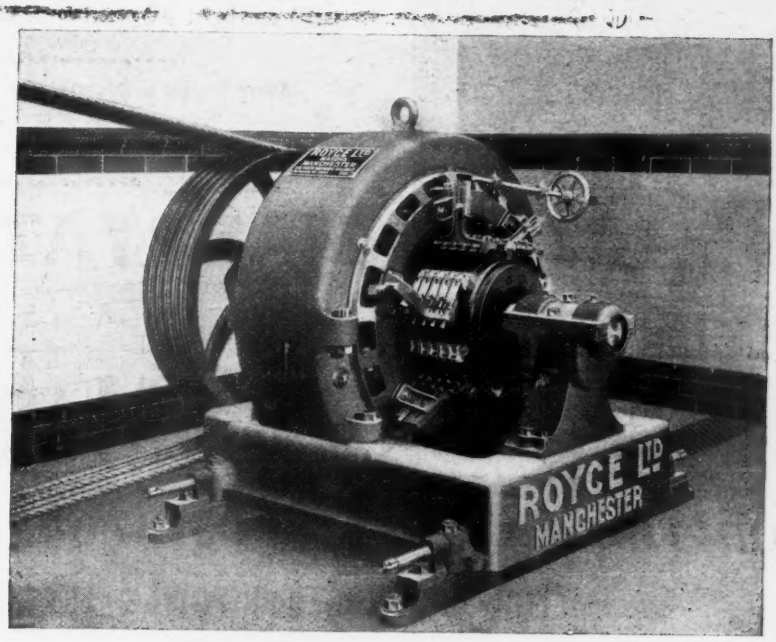

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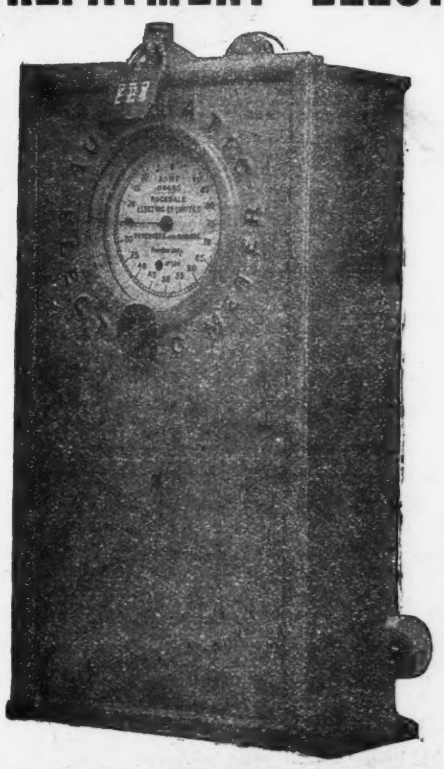

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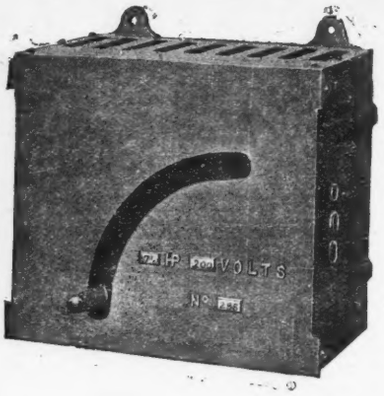

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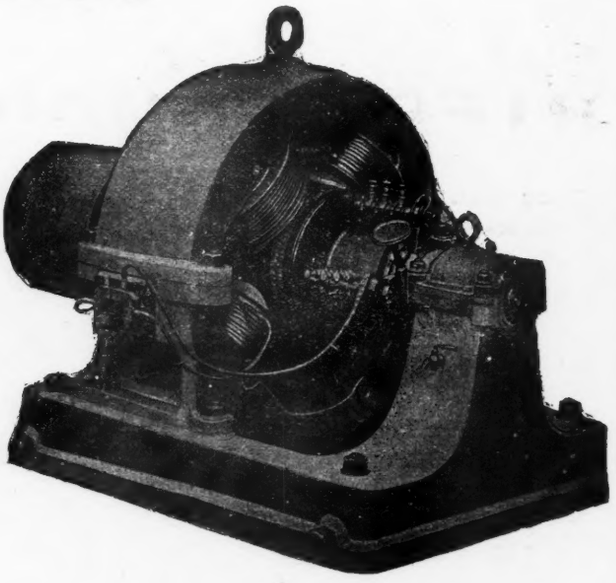

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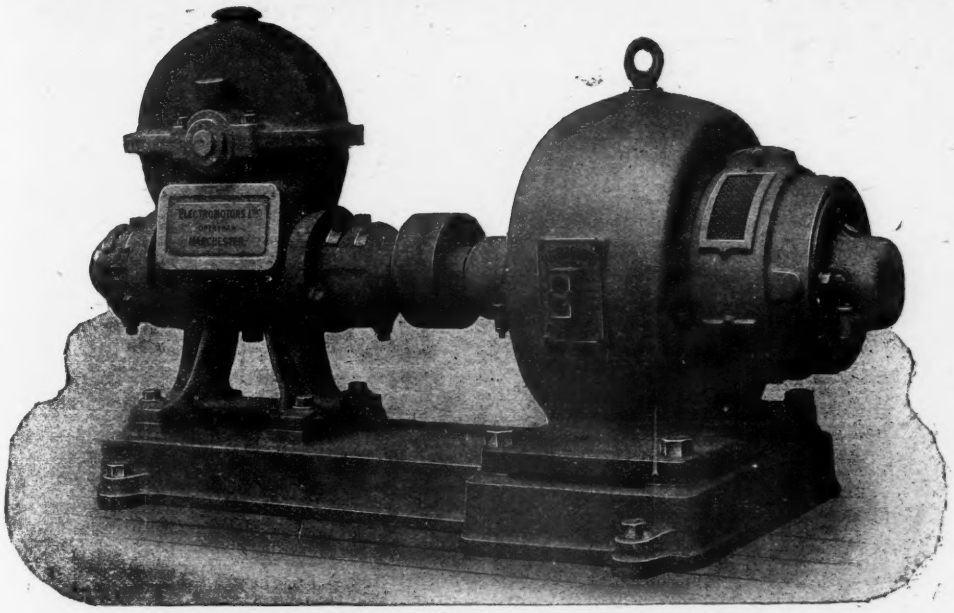

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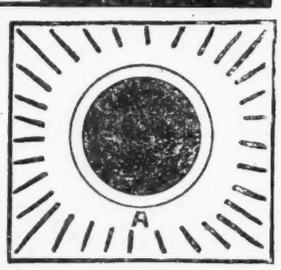
The black disc in the diagram A shows the life of other high efficiency lamps, the white disc shows the greater life of the Premier Lamp.



The black coil in diagram B shows the watts used per 1000 hours by other high efficiency lamps, the dotted coil shows the watts used by the Premier Lamp per 1000 hours, the white coil showing the saving.

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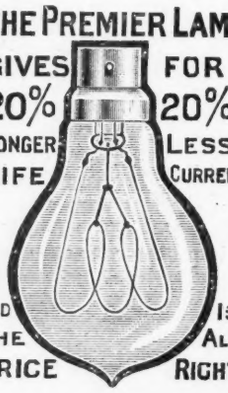

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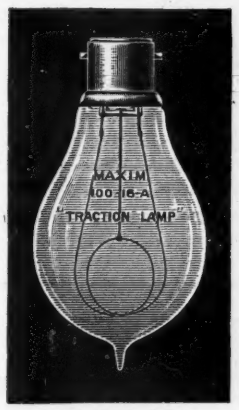

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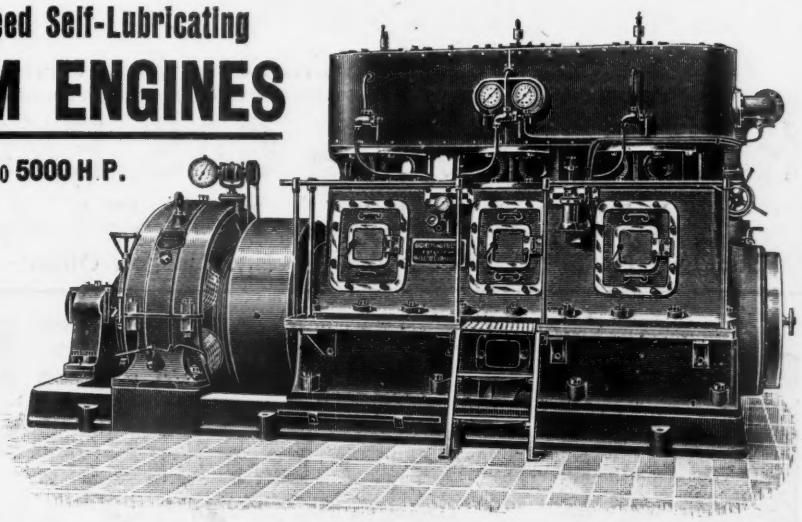

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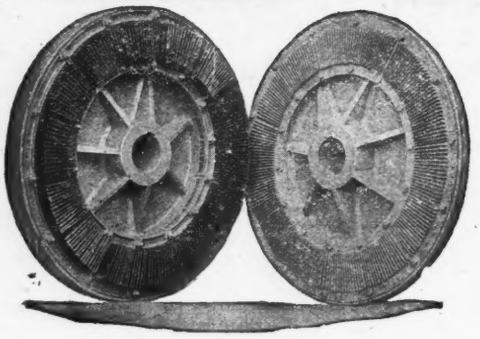

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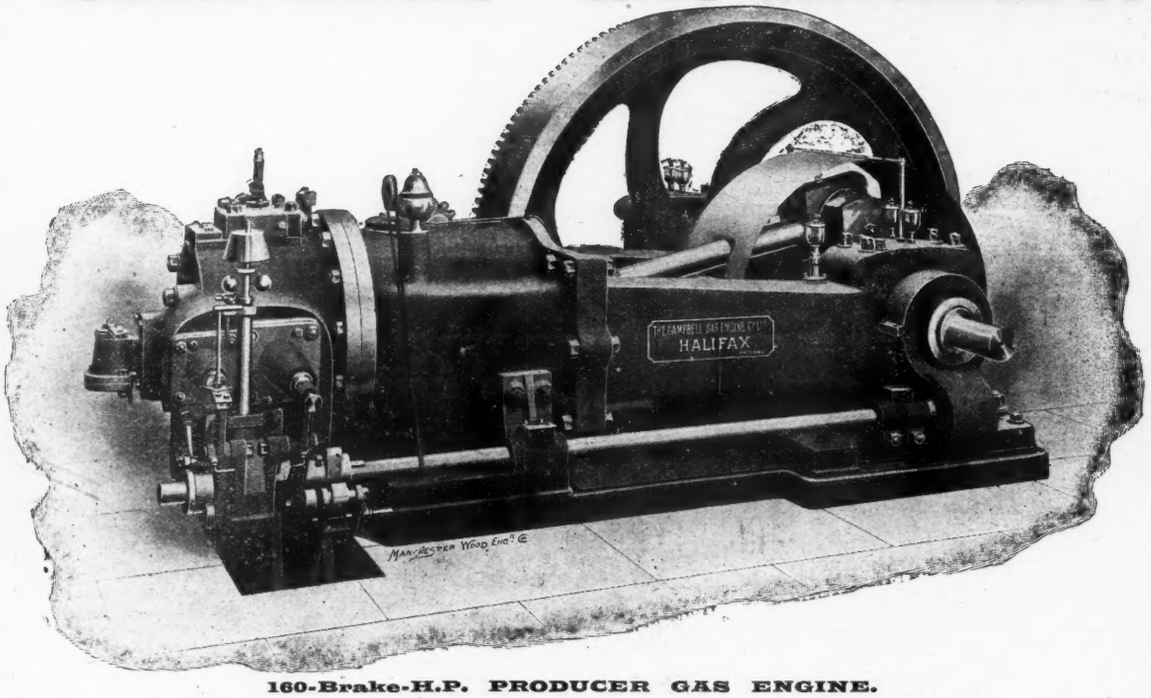

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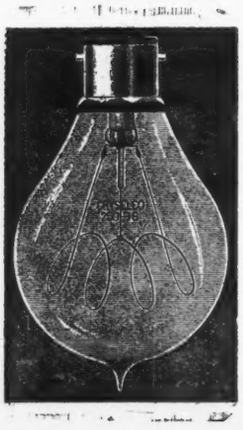

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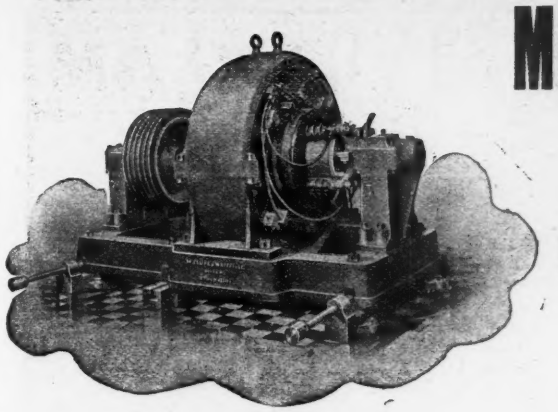

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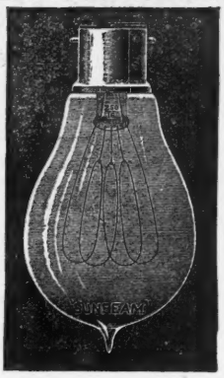

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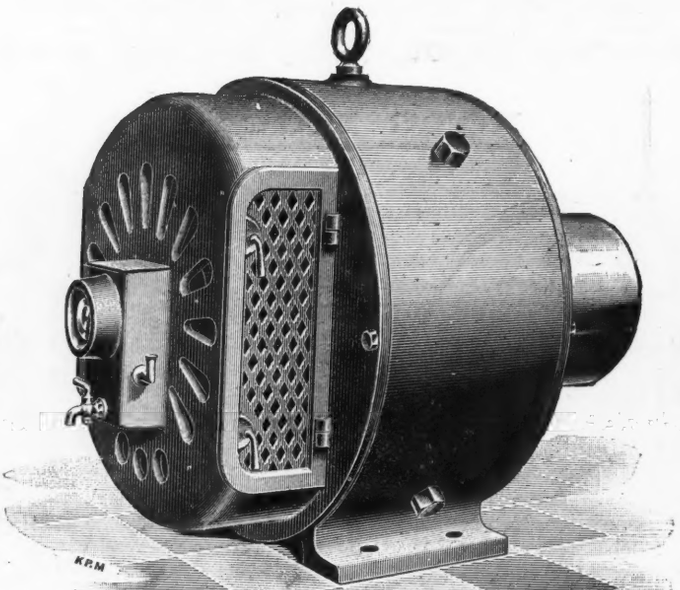

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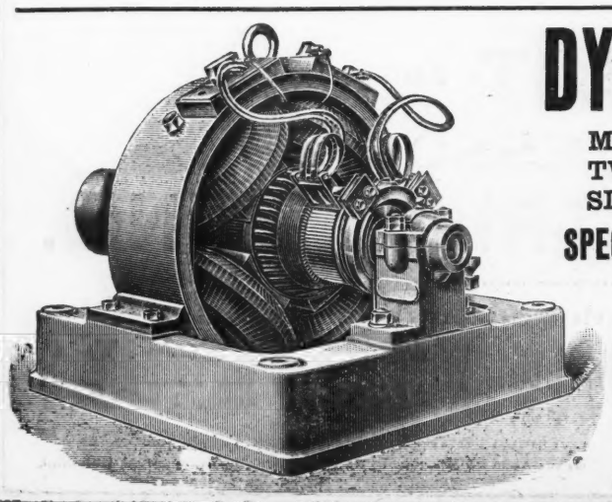

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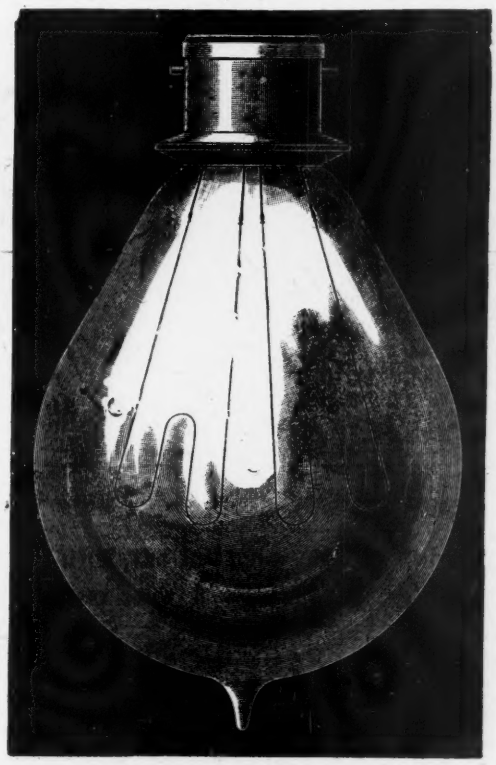

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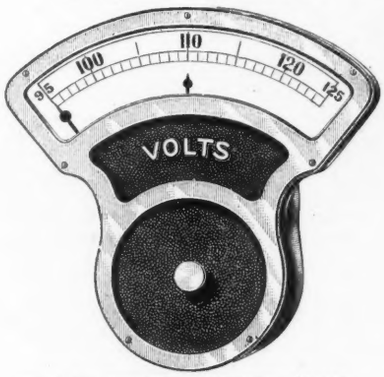

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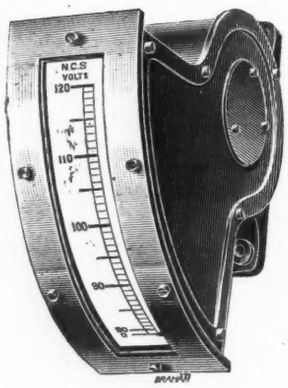

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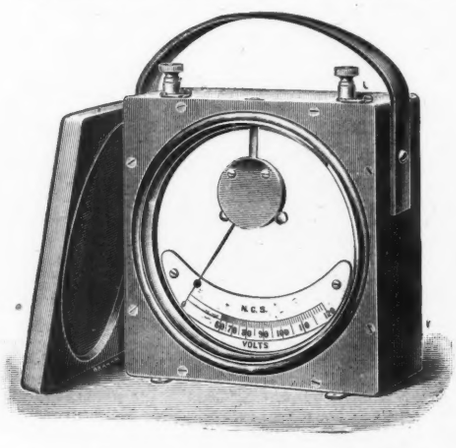

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THE ELECTRICITY COMMITTEE of the Council are prepared to receive Tenders for the following:—

Section B.—Supply and delivery of
(*a*) Private Lighting Cables (Paper).
(*b*) Public Lighting Cables (Rubber).
(*c*) Joint Boxes and Compounds.

Section C.—Supply, delivery and erection of 20 Arc Lamp Columns with Incandescent Brackets, complete with Arc and Incandescent Lamps, Cut-Outs, Switches, Resistances, and all Accessories.

Tenderers are at liberty to quote for one or all of the sections or sub-sections, but not for part of a sub-section.

Specifications and Forms of Tender may be obtained from the undersigned on depositing the sum of Two Guineas for each Section, which sum will be returned on receipt of a *bonâ fide* Tender.

Sealed Tenders endorsed "Tender for Cable," or Tender for Arc Lamps," as the case may be, and addressed to the Chairman of the Electricity Committee, Electricity Works, Nuneaton, must be delivered on or before July 2nd, 1902.

S. CAMERON GIBSON, A.M.I.E.E.,
Electrical Engineer.

Electricity Works,
Coton Road,
Nuneaton.

7985

DEVON COUNTY COUNCIL.

THE VISITING COMMITTEE of the Devon County Asylum, Exminster, is prepared to receive Tenders for the following works:—

Section I.—Wiring Alterations and Additions.
" II.—2000 Lamps.
" III.—Booster, Dynamo and Motors.
" IV.—Switchboard.
" V.—Replating of a Battery of 120—700 ampere hour cells, &c.

Plans and General Conditions of Contract may be inspected, and Specifications obtained, at the Offices of the Council's Consulting Engineers, Messrs. O'GORMAN & COZENS-HARDY, 82, Victoria Street, Westminster, on and after June 25th, upon deposit of Five Guineas, which will be returned on receipt of a *bona fide* tender, which must reach the undersigned at the Castle, Exeter, before noon on WEDNESDAY, JULY 23rd, 1902.

The Committee do not bind themselves to accept the lowest or any tender, nor will they pay any expenses in connection therewith.

H. MICHELMORE,
Clerk to the Devon County Council.

8029

Official Notices.—*Continued.*

TO MAKERS OF ELECTRICAL TRAMCARS.

THE LONDON COUNTY COUNCIL is prepared to receive Tenders for the manufacture and delivery of 80 Double-decked Electric Tramcars, complete with Trucks, Motors, Controllers, Ploughs, &c., for the service of the Council's Conduit Tramways. Persons desiring to submit Tenders may obtain the Specification, Schedule of Quantities, Form of Tender, Drawings, and other particulars, at the County Hall, Spring Gardens, S.W., upon payment of the sum of Two Pounds. This amount will, after the Council or its Committee shall have come to a decision upon the Tenders received, but not before, be returned to the tenderer, provided he shall have sent in a *bonâ fide* Tender, and not have withdrawn the same. Tenders must be upon the Official Forms, and the printed instructions contained therein must be strictly complied with. The contractors will be bound by the contract to pay to all workmen (except a reasonable number of legally bound apprentices) employed by them, wages at rates not less, and to observe hours of labour not greater, than the rates and hours set out in the Council's list; and such rates of wages and hours of labour will be inserted in, and form part of, the contract by way of Schedule. Each Tender is to be delivered at the County Hall, in a sealed cover, addressed to "The Clerk of London County Council, Spring Gardens, S.W.," and marked, "Tender for Rolling Stock—L.C.C. Tramways." No Tender will be received after 10 o'clock a.m. on TUESDAY, JULY 15th, 1902. Any Tender which does not comply with the printed instructions for tender may be rejected.

The Council does not bind itself to accept the lowest or any Tender, and it will not accept the Tender of any person or firm who shall on any previous occasion have withdrawn a Tender after it had been opened, unless the reasons for the withdrawal were satisfactory to the Council.

G. L. GOMME,
Clerk of the Council.

County Hall,
Spring Gardens, S.W.
June 25th, 1902.

8059

URBAN DISTRICT OF EPSOM.

ELECTRIC LIGHTING EXTENSION PLANT.

THE EPSOM URBAN DISTRICT COUNCIL are prepared to receive Tenders for the supply and erection of the following plant:—

Contract 1.—Semi-marine Dryback Boiler with Fittings, &c.
" 2.—Ejector Condensers, Circulating Pumps, and Pipework.
" 3.—Spray Cooling Pond.
" 4.—Steam, Feed, and Drain Pipes, &c.
" 5.—One 150 KW. Steam Dynamo (Vertical Enclosed High-speed Engine) and Switchgear, &c.

Persons tendering are at liberty to tender for any contract or contracts, or for the whole of the contracts, but not part of one contract.

Tenders will be considered from those firms only who have plant of similar size and type working satisfactorily in other electricity supply works.

Copies of Specification, with Form of Tender, General Conditions and Plans, can only be obtained at the offices of the undersigned on and after June 18th, 1902, on depositing a cheque for Five Guineas, which sum will be returned on receipt of a *bona fide* tender. Applicants to state the contracts for which they propose tendering.

The works will be carried out in accordance with the Plans and Specifications prepared by Mr. W. C. C. Hawtayne, of 9, Queen Street Place, London, E.C., Consulting Engineer to the Council, from whom further information may be obtained on and after the 18th June, 1902.

Tenders, sealed and marked "Tender for Electric Lighting Extension Plant," to be addressed to the Clerk to the Council, Council Offices, Epsom, and to be delivered on or before 12 o'clock noon on the 18th JULY, 1902.

The Council do not bind themselves to accept the lowest or any tender.

(Signed)
E. G. WILSON,
Clerk to the Council.

Council Offices,
Epsom.

8010

[*Continued on page* 16.]

Official Notices.—*Continued.*

STALYBRIDGE, HYDE, MOSSLEY AND DUKINFIELD TRAMWAYS AND ELECTRICITY BOARD.

Contracts Nos. 4 and 5.

THE BOARD are prepared to receive Tenders for the supply, delivery, erection and construction of the following:—

Contract No. 4.
Section A.—Three 500 KW. Steam-driven Direct-coupled Three-phase Alternators, &c.
Section B.—Three 50 KW. Steam-driven Direct-coupled Continuous Current Exciters, &c.

Contract No. 5.
Permanent Way, including Copper Bonding and Conduits for Cables.

Tenderers are at liberty to tender for any one or all of the Sections but not for part of a Section.

Specifications and Forms of Tender may be obtained from the undersigned on making a deposit of One Guinea in respect of each contract, which amount will be returned on receipt of a *bonâ fide* tender.

Tenders are to be on the prescribed form, accompanied by a further deposit of Five Guineas (which amount will be returned to those whose tenders are in order but not accepted), together with the Specification and General Conditions intact, sealed and endorsed "Contract No. 4" or "Contract No. 5," as the case may be, and delivered to the undersigned on or before MONDAY, JULY 7th, 1902.

The Board do not bind themselves to accept the lowest or any tender.

FRANK SCHOFIELD,
Clerk to the Board.

Town Hall,
Stalybridge,
June 10th, 1902. 7973

BURGH OF FALKIRK.

ELECTRIC LIGHTING.

THE CORPORATION are prepared to receive Tenders for the supply and erection of the following:—

No. 4.—Steam, Exhaust, Drain and other Pumps, Feed Pump, Tank, &c.
No. 5.—Balancing Transformers and Motor Generators.
No. 6.—Storage Batteries.
No. 7.—Switchboard and Connections.
No. 8.—Arc Lamps, Incandescent Lamps, and Fittings.
No. 9.—Cable Work.
No. 11.—Travelling Crane.

The Specifications, Plans, &c., can be inspected, and all information obtained, at the offices of Messrs. BURSTALL & MONKHOUSE, Consulting Engineers to the Corporation, 14, Old Queen Street, Westminster, S.W., where copies of the Specifications with Form of Tender, General Conditions of Contract, and Plans, can also be obtained on and after the 20th June, 1902, on payment of £2 for each Specification, which amount will be returned if a *bona fide* tender is received by the time stated below. Extra copies of the Specifications can be obtained at 5s. per copy; this amount will not be returned.

The Corporation do not bind themselves to accept the lowest or any tender, and the contractor whose tender is accepted will be required to enter into a formal agreement, under seal, with two securities for the due fulfilment of the contract.

Sealed tenders addressed to me, and endorsed "Tender for Electric Lighting, Contract No. —," must be delivered at my office at the Municipal Buildings, Falkirk, N.B., not later than 12 o'clock noon on the 14th JULY, 1902.

A. BALFOUR GRAY,
Town Clerk. 8006

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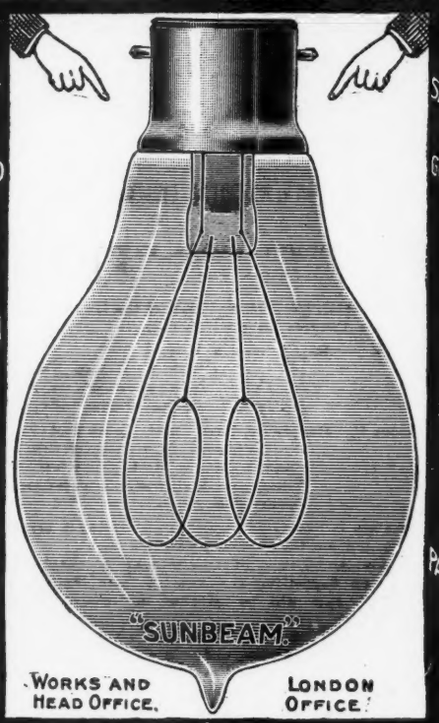

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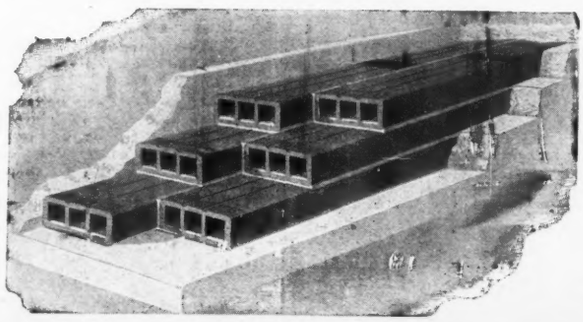

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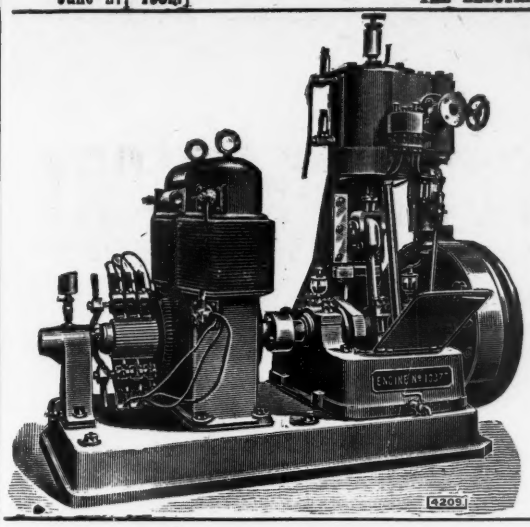

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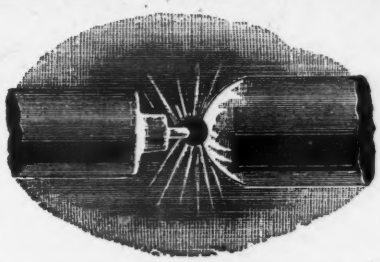

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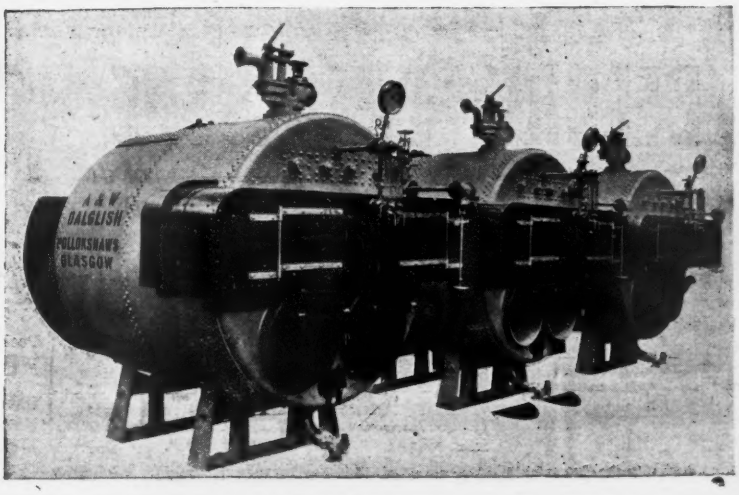

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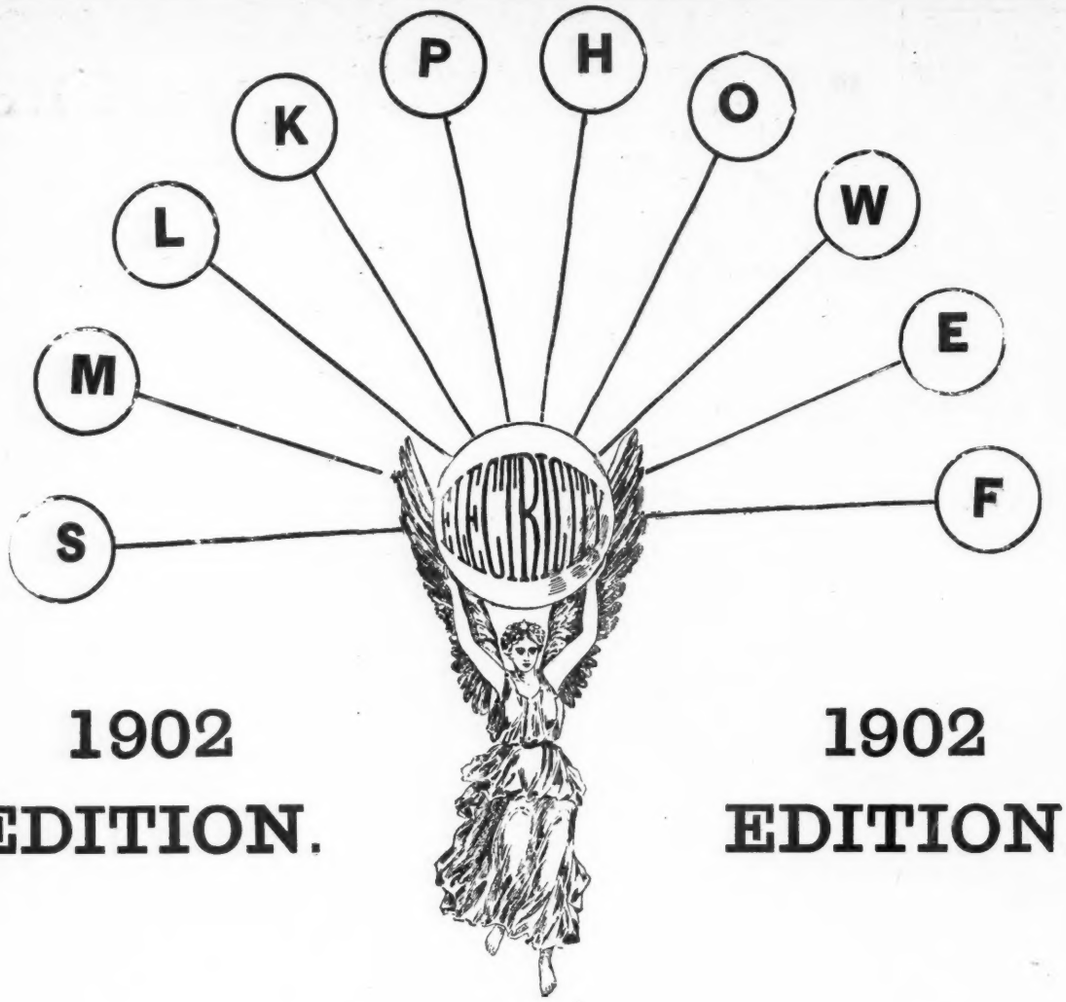

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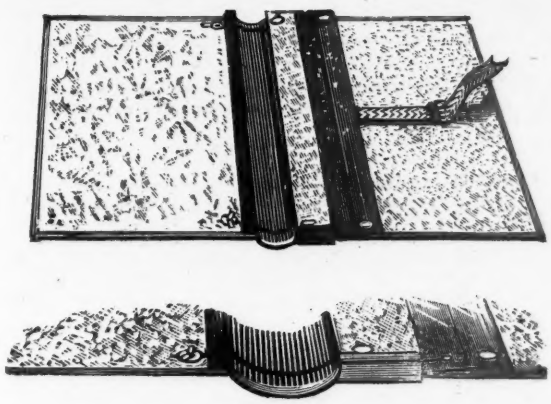

PATENT

SELF-BINDERS

FOR

THE 'ELECTRICAL REVIEW."

THIS Self-Binder, or Reading Case, is intended to hold ELECTRICAL REVIEWS of any number until the half-yearly volume is completed and ready for permanent binding, the width of the back being widened or contracted by sliding the back cover in or out as desired.

To be obtained at the ELECTRICAL REVIEW Office, 22, Paternoster Row, London.

Price 6s., Post Free (in Great Britain) 6s. 6d.

Cheques and Money Orders to be made payable to H. ALABASTER the latter on Chief Office, London.

"ELECTRICAL REVIEW."

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TRAMWAY VALUATIONS & ARBITRATIONS.

WHEATLEY KIRK, PRICE & CO.

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ELECTRICAL & MECHANICAL VALUERS, ARBITRATORS, AND AUCTIONEERS,

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ELECTRIC POWER and TRACTION ENGINEERS.

Head Office:

49, Cannon St., London, E.C.

Telegrams: "WITTING, LONDON." Telephone: 5795, Bank.

SITUATIONS VACANT.

If letters are not to be delivered to certain firms or individuals (if known), instructions to that effect should be sent to the Manager of the ELECTRICAL REVIEW, who will do his best to carry out such instructions. Letters of applicants cannot in such cases be returned to them, nor can the names of Advertisers using a number or a *nom de plume* in any way be disclosed.

Original Testimonials should never be sent.

STALYBRIDGE, HYDE, MOSSLEY AND DUKINFIELD TRAMWAYS AND ELECTRICITY BOARD.

Appointment of Inspectors.

THE ABOVE BOARD is prepared to receive applications for the appointment of about half-a-dozen Permanent Way Inspectors, and also Inspectors for laying electric cable conduits.

The appointments will be temporary, but it is expected that the work will last for at least nine months.

Applicants, who must be experienced in the classes of work respectively, to send full particulars, including wages required, copies (only) of testimonials, to the undersigned.

ALFRED H. GIBBINGS, M.I.E.E.,
Engineer-in-Chief.

Town Hall,
Stalybridge,
June 10th, 1902. 7206

TO ELECTRICAL ENGINEERS.

THE LONDON COUNTY COUNCIL requires the services, in the Electrical Branch of its Tramways Department, of an Electrical Distribution Engineer. He will be required to superintend, under the direction of the Chief Officer of the Department (*a*) the Manufacture, Laying and Connecting of Underground Cables, &c.; (*b*) the erection of Switchgear and Transforming Apparatus and Machinery in the Sub-stations; and to be responsible for the proper working and maintenance of the Electrical Distribution System, including the Sub-stations, but exclusive of the Power Stations and the Rolling Stock.

The Salary attached to the appointment will be £350 a year, and the gentleman appointed will be required to give his whole time to the duties of his office, and to conform to the Council's regulations in respect to the Superannuation and Provident Fund, in the benefits of which he will participate.

Forms, on which application for the appointment is to be made, can be obtained from the Clerk of the Council, Spring Gardens, S.W., and the latest time for receiving applications is 10 o'clock a.m. on Monday, 14th July, 1902.

Personal canvassing of the members of the Council is strictly prohibited.

G. L. GOMME,
Clerk of the Council.

County Hall, Spring Gardens, S.W.
June 25th, 1902. 8063

[*Continued on next page.*]

SITUATIONS VACANT.—*Continued.*

BOROUGH OF BARROW-IN-FURNESS.

WANTED, Improver to assist in testing department and general work in generating station. Applicants must have had a theoretical training at technical college.—Applications, endorsed "Improver," and stating age, experience (theoretical and practical) and salary required, to be addressed to H. R. BURNETT, Borough Electrical Engineer, Barrow-in-Furness. 8067

BOROUGH OF SWINDON.

Appointment of Electrical Engineer and Tramways Manager.

THE CORPORATION OF SWINDON invite applications from properly qualified persons for the post of Electrical Engineer and Tramways Manager at a salary of £250 per annum.

The generating station is now in course of erection, and all the contracts for plant are let. The person appointed will be required to take up his duties about the beginning of October next.

The Corporation have obtained a Provisional Order authorising them to construct and work Tramways, and the person appointed will be required to supervise the laying of the Permanent Way, and the Overhead Equipment, and afterwards to act as Tramways Manager.

Further particulars may be obtained on application to the undersigned.

Canvassing in any form will be deemed to be a disqualification.

Applications, stating age and experience, endorsed "Electrical Engineer," accompanied by not more than three testimonials, to reach the undersigned not later than Wednesday, the 9th July next.

(By Order),
ROBT. HILTON,
Town Clerk.

Town Hall,
Swindon, Wilts.,
June 23rd, 1902. 8062

EDINBURGH CORPORATION ELECTRIC LIGHTING.

THE MAGISTRATES and COUNCIL invite applications for the post of Assistant to the Superintendent of Mains.

Candidates must state their age and previous experience, and send copies of testimonials. Salary to commence at the rate of £150 per annum.

Applications to be sent to the Resident Electrical Engineer, Dewar Place, Edinburgh, on or before Monday, July 7th, 1902.

THOMAS HUNTER, W.S.
Town Clerk.

City Chambers, Edinburgh,
June 19th, 1902. 8053

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Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two.

Box Number and ELECTRICAL REVIEW address count as seven words.

COMMERCIAL Engineer, experienced in light and power installations for London sales office: capable of corresponding, estimating, or advising installers and users. Fullest details in strictest confidence.—7983, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7983

DRAUGHTSMAN wanted, accustomed to general engineering and dynamo construction. Applicants to state previous experience and salary required.—Address, 7862, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7862

DRAUGHTSMAN wanted in London electrical firm. State experience, age and wages at last situation, and whether at present disengaged. Commencing salary, 30s. weekly.—Address, "Box D.," Tayler's Advertisement Offices, 154, Fleet Street, E.C. 8052

SITUATIONS VACANT.—*Continued.*

ESTIMATING Clerk for electric cable works, with some knowledge of the work.—8065, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 8065

FOREMAN wanted, switchboard shop, London works. Extended experience in all forms of motor starting and control apparatus also necessary. Experienced in the latest machine tools, repetition work, jigs and templates, knowledge of piecework. Good control of men. Only experienced men need apply, stating age, experience and salary required.—8068, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 8068

HOUSE Carpenter, who is also capable of working an electric lighting plant, with oil engine and storage battery. Cottage provided. State wages and experience.—Apply, DRAKE & GORHAM, LTD., Electrical Engineers, 66, Victoria Street, Westminster, S.W. 8051

MAIN Laying.—Cable company has a vacancy for an electrical engineer with experience in laying underground electrical mains, competent to take entire charge; one with experience in tramway work preferred.—Write (in confidence), stating experience, age and salary required, "Z. R., 120," Deacon's, 154, Leadenhall Street, E.C. 8050

PUPIL.—Vacancy for Pupil in large northern corporation electricity works. Further extensions coming on. Good chance for appointment later. Premium £50.—Apply 7931, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7931

VACANCY for Pupils in the electric lighting department of a high class West End house, where there is good scope for advancement. Premium £100 for smart energetic youths.—Apply, 7901, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7901

VACANCY for Apprentice with an old-established firm of electrical engineers. Premium required.—Apply 8055, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 8055

WANTED.—Junior Draughtsman for Electrical Works in London. Must be experienced in switch gear, instruments, and accessories.—Apply, stating salary, 8056, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 8056

WANTED a competent Foreman to undertake erection of isolated installations.—State age, experience, wages required, to 8057, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 8057

WANTED.—Two competent Draughtsmen. Must have had good engineering training, and have knowledge of dynamo work.—Apply stating experience, &c., to THE SUNDERLAND FORGE AND ENGINEERING CO., LTD., Sunderland. 7865

WANTED.—Youth for electrician's office, able to travel, London district. Shorthand and typewriter preferred. State salary required.—Box 7978, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7978

WORKS Manager for chemical works; active and accustomed to control men; experienced in electro-chemistry preferred. Only capable and practical men need apply.—Write, stating age, experience, and salary required, in confidence to "Z. P. W.," c/o Willings, Piccadilly, London. 7977

SITUATIONS WANTED.

Where advertisements are to be answered to a given number, letter, *nom de plume* at the ELECTRICAL REVIEW Office, applications for names and addresses of the Advertisers will be entirely disregarded.

Cheap Prepaid Advertisements are inserted under this heading at the rate One Penny per word (minimum 1s.). Three Consecutive Insertions for the price of two.

Box Number and ELECTRICAL REVIEW address count as seven words.

ADVERTISER (24) desires permanent situation with large wiring contractors in Yorkshire; 7 years' practical experience in light, bells, telephones, motors. Good references as to character and capability. Wages 8½d.—Box 7907, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7907

(*Continued on next page.*)

SITUATIONS WANTED.—*Continued.*

ADVERTISER (32), six years' experience in design and construction of electric motors, &c., seeks position of trust; used to control of men and latest shop practice.—8000, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 8000

ADVERTISER requires re-engagement as Meter Reader, thoroughly used to all kinds of electric meters. Five years' experience. Highest references.—8021, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 8021

ELECTRIC Engineer (24), married, desires engagement; winding, wiring, fitting, and turning.—8020, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 8020

ELECTRICAL Engineer (26), A.I.E.E., desires re-engagement. 10 years' experience in workshop, college, testing, lighting, tramway, and cable laying work. Has capital would invest in well established firm.—8003, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 8003

ELECTRICAL Engineer and Plant Attendant, six years' practical experience in America.—Gentleman (aged 30) requires employment in S. Africa, Egypt or the Colonies. Will put money in business if necessary.—Apply, "D.," Loughlinsborm House, Co. Dublin. 7941

ELECTRICAL Engineer (33) desires Appointment; thorough commercial and technical experience; lighting, power, transmission, motor and installation work; strict organiser.—"ELECTRIC," 13, Houghton Terrace, Blandford Road, Beckenham. 8007

ELECTRICAL Engineer, with six years' practical experience, diploma from first-class technical college in Germany, commanding five languages, now employed by firm of electrical engineers in England, wants situation either at home or in colonies; would also go abroad if conditions sufficiently tempting. First-rate references and testimonials.—7965 ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7965

ELECTRICIAN (22), certificates first-class, both practical and theory, desires situation. Used to high speed engines and dynamos, arc lamps, &c.—Apply, ELECTRICIAN, c/o G. Harrison, Newsagent. Conisboro'. 7998

ELECTRICIAN, used to arc lamps, installation of plant, gas or steam engines, 12½ years last employment; total abstainer.—A. JONES, 26, Northern Road, Plaistow, E. 7992

ELECTRICIAN seeks engagement; 20 years' varied experience in erecting and running complete light and power installations, also office work and testing. Used to large printing presses and the Ward-Leonard, and other systems. Knowledge of French and German.—WARD, 17, Nigel Road, Peckham Rye, S.E. 8017

HANDY-MAN (32) desires situation, charge of private electric light plant; thorough knowledge of gas and oil engines, dynamos and accumulators, also knowledge of steam engines, able to do any jobbing work to fill up time. Good references.—Apply H. CLEMENTS, 73, Swinbrook Road, North Kensington, London. 8043

MACHINE Shop Manager, having just finished 10 years with Ediswan, desires engagement, home or abroad. Well up in all kind of repetition work, estimating and tool making. Advertiser speaks English, French and German.—J. MULLER, 187, Nagshead Road, Ponder's End. 7985

MECHANICAL and Electrical Engineer (34), Board of Trade certificate; long experience construction and maintenance, high-tension, three-phase power and lighting plants; good organiser, energetic, and thoroughly practical, desires position as Assistant to consulting engineer. Charge of installation or operating, or would entertain partnership.—8009, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 8009

SITUATIONS WANTED.—*Continued.*

SMART Salesman (26), seeks re-engagement; thorough general knowledge, good connection, highest references. — 7780, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7780

WANTED.—Secretary, F.I.S., Accountant or Commercial manager. Advertiser, over 20 years' actual experience in secretarial and accountancy work, with most successful mechanical and electrical engineers. Accustomed to control staff, experienced in company law, well up in works costs and modern organisation. First-class references.—Address 8031, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 8031

WIREMAN seeks engagement.—W. ROBINSON, 43, Baron Road, Canning Town, E. 7993

WIREMAN disengaged; casing, conduit, bells, telephones, references.—ELECTRICIAN, 64, Rosebury Road, Fulham. 8014

WIREMAN wants work (good).—PHILLPOT, 3, Ramleh Villas, Langroyd Road, Tooting. 8010

YOUNG Engineer (A.M.I.E.E.) seeks berth in a small consulting or contracting business. Could invest a few hundreds.—7884, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7884

YOUNG Man (20) wants job as Wireman's Mate.—"A. P.," 174, Prince of Wales Road, Camden Town. 7917

YOUNG Man (24) desires situation as Wireman's Assistant; experienced. — "L.," Lisburne House, Lisburne Road, Hampstead. 7906

PARTNERSHIPS.

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Box Number and ELECTRICAL REVIEW address count as seven words.

AN Electrical Contracting Firm in London having a turnover of £6000 per annum desires to purchase or amalgamate with a similar concern with a view to economising in administration expenses; strict investigation.—Apply 7908, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7908

PARTNERSHIP. — Engineer, 14 years' varied experience, special intimacy traction, desires employment with consulting, civil or electrical engineer, about to take up such work, with view to partnership.—Address, 7864, ELECTRICAL REVIEW, 4, Ludgate Hill London. 7864

AGENCIES.

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A FIRM of electrical engineers in British Guiana desires to represent a good English firm.—Address, 7904, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7904

A FIRM of manufacturing electrical engineers, partly engaged in electric lighting and power installation work, require to meet with an Agent for electrical accessories with a view of reciprocating.—Apply, 8063, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 8063

AGENTS wanted for switch and fuse boards.—Reply, 7990, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7990

(*Continued on next page.*)

AGENCIES.—*Continued.*

AGENCY.—Firm of engineers and electrical contractors in the North of England, with good connection, are desirous of obtaining Agency for a first-class speciality.—Reply, 7890, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7890

FOR SALE.

FOR Sale about the end of June, Electric Machinery Plant, &c., as follows:—

Two Crossley's "Otto" Engines 16 nominal H.P., with slide ignition, silencers, exhaust boxes, gas bags, &c., complete. (These engines could be disposed of at once).
Two Rectangular Steel Tanks, 10′ 6″ × 7′ 4″ × 3′, capacity of over 1400 gallons each.
One new Electric Construction Company's Compound Dynamo, 215 to 280 volts 160 amps., 725 revolutions, 9″ pulley 10″ face, with slide rails, switch, shunt resistance, &c., complete.
Two Morley's Compound Dynamos, 220 volts 85 amps., 1050 revolutions, 10″ pulley 9″ face, with slide rails, shunt resistance, &c., complete.
Two Smith's Patent Screw-split Pulleys, 42″ × 9½″ × 3″.
One ,, ,, ,, ,, 34″ × 11″ × 4½″.
One ,, ,, ,, ,, 46″ × 8″ × 3″.
Two 10 ft. lengths 3″ steel Shafting.
Six A Swivelling Hangers for above 3″ shafting.
Two 29″ × 10½″ Cast-iron Pulleys.
One Ridge-Hayward 18″ × 6″ Friction Clutch.
Quantity of 9″, 8″, &c., Reddaway's Camel Hair Belting.
Quantity of Gas, Water and Exhaust Piping.
A battery of 110 Pritchett & Gold's new type Cells, 27 plates, in glass cells, with insulators, &c.; condition good as new.

—Can be seen by appointment at Messrs. JONES BROS., Oakwood Court, Addison Road, Kensington, W. 7098

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DYNAMO, shunt wound, 135 volts 23 amperes, slide rails, only used three months.—BAXTER & IMPEY, Dudley Street, Birmingham. 8029

ELECTRIC Installation, ready for delivery, consisting of Mather & Platt Multipolar Dynamo, 250 volts and 1400 amperes at 105 revs., and Galloway 600 H.P. Vertical Engine, cylinders, 18 in. and 34 in.; stroke, 36 in., Corliss valves.—For full particulars and price apply GALLOWAYS LIMITED, Manchester. 6778

FOR Sale.—Two 70-KW. shunt wound, multipolar Dynamos, 210 volts, in good order, by J. P. Hall & Co., can be seen working; also spare Armature for same; also three Link Belts, 18″ wide; also one perfectly new Brown-Boveri 14-H.P. shunt wound Multipolar Motor, 220 volts; also one "Pieper," 27-H.P. shunt wound Multipolar Motor, 220 volts, in perfect condition, very little used.—Further particulars on application to WARREN BEATTIE & Co., LTD., Middlesbrough. 7969

FOR Sale, cheap, a number of Johnson & Phillips "Ark" lamps. Can be inspected by appointment.—Address, 7999, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7999

FOR Sale or Hire, high class dynamos, motors, alternators, cable and arc lamps.—PERCY HUDDLESTON & Co., 72, Finsbury Pavement, E.C. 7148

FOR Sale by desire of the Debenture Holder.—An electrical manufacturing and accessory business, situated near the City. Principals or their solicitors only treated with. — 7856, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7856

FOR Sale, as a going concern, wire covering and magnet winding Business, with all patent rights, plant, stock-in-trade, &c.—Address, VARLEY MAGNET COMPANY, LIMITED, Lodge Lane, Derby. 7561

FOR SALE.—*Continued.*

FOR Sale.—Three Searchlights, nearly new.—ELECTRICIAN, Elder, Dempster & Co., Avonmouth Dock, Bristol. 7881

FOR Sale.—Nearly new electric lighting plant, comprising 20 brake horse-power gas engine, dynamo, 200 volts 60 amperes, switchboard, belting, water-tanks, piping, &c., complete.—Apply, SECRETARY, Northgate Mansions, Ltd., Gloucester. 7911

SEARCHLIGHT Projector, 24-in., for Sale.—MARTIN, Coventry Street, Kidderminster. 8005

THE Lease, Goodwill, Plant with Fittings of an electrician's business to be sold. A bargain; good opening.—Apply, Messrs. ROBSON & PERRIN, Auctioneers, 39, Stroud Green Road. 7916

THREE Electric Phaetons and two Electric Vans, fitted Lundell motors, cheap for immediate sale; also four 3 H.P. Motors, by Crompton.—Repository, 45, Broadway, Walham Green, London. 8061

1-H.P. Langdon-Davies Motor, alternating current, 100 volts, 50 periodicities, complete with resistance and switch, nearly new. £11 or offer.—WALLACE, Engineer, London Road, Croydon. 8054

ARTICLES WANTED.

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PLATINUM, in any form and quantity, purchased at highest prices by DERBY & Co., 44, Clerkenwell Road, London. 8529

WANTED.—Electric Lamp Tops and Scrap Platinum.—EDEY AND Co., 29, Ludgate Hill, London. 7970

WANTED, Alternating Current Motors, shunt wound, enclosed, about 1/6 or 1/8 H.P., 600 to 800 revs. Various voltages and cycles.—Apply by letter, stating full particulars, to 76, Church Street, Blackpool. 7880

WANTED.—1300 yards 7/16 S.W.G. single armoured cable in two equal lengths, suitable for 500 volts, armouring not less than 12 S.W.G., braided and served. Particulars and lowest price to Messrs. THE MADELEY COAL AND IRON CO., LTD., Madeley and Leycett Collieries, Madeley, near Newcastle, Staffs. 7989

MISCELLANEOUS.

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ACCUMULATOR CHARGING.—C. H. Cathcart & Co., having plant specially adapted for this purpose, charge cells of all sizes promptly, thoroughly and cheaply. Terms on application. Accumulators on hire for temporary lighting, experimental uses, &c.—3, Dorset Buildings, Salisbury Square, Fleet Street, E.C. (Telephone No. 266, Holborn). 7355

EPSTEIN Accumulator Plates for Storage Batteries are now supplied by the sole licensees and makers, W. O. ROOPER AND Co., Electrical Engineers, Stafford. 86

EVERSHED Ohmmeter for hire, 2s. 6d. per day. — Westminster Electrical Testing Laboratories, 14, Great Smith Street, Westminster. 7697

HOW to become an Electrical Engineer.—See special series of articles commencing in July 1st issue of *The Model Engineer*. Of all Newsagents 2d., or post free 3d. from DAWBARN AND WARD, LTD., 6B, Farringdon Avenue, London, E.C. 8027

(Continued on next page.)

MISCELLANEOUS.—*Continued.*

SEARCHLIGHTS for sale or loan. — JOHNSON & PHILLIPS, Victoria Works, Charlton, Kent. 2045

WIRES and CABLES for the CORONATION.—All sizes, every description, large stocks, immediate delivery. Low prices for present stock. Samples and prices on application, with full particulars as to sizes required. Send trade references with enquiry to save delay.—A. H. HUNT, 115—117, Cannon Street, London, E.C. 7875

IMPORTANT

GRAHAM, MORTON & Co. Ltd.,

Works: **LEEDS.**

MAKERS

Conveying Plants.

We have just completed one large contract for our labour-saving appliances value £120,000, and we are now erecting another value £112,000.

THE ELECTRICAL REVIEW.

CHEAP

PREPAID ADVERTISEMENTS,

(Latest time for receiving 2 p.m. Thursdays).

Relating to Situations Vacant, Situations Wanted, Businesses Wanted, Businesses for Sale Patents for Sale, Specific Articles of any kind Wanted, or for Sale or Exchange, are inserted at the rate of ONE PENNY Per Word (minimum 1s.).

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*** This Scale does not apply to Trade Advertisements, terms for which can be had on Application to 4, Ludgate Hill, London, E.C.

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Advertisers will please note that NEW COPY and ALTERATIONS TO EXISTING ADVERTISEMENTS should reach here NOT LATER THAN MONDAY MORNING.

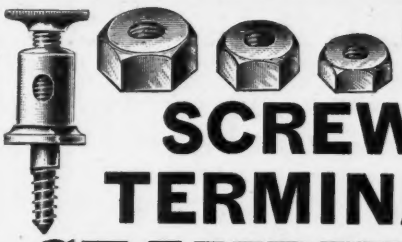
The "Electrical Review," is the recognised medium of the Electrical Trades,

AND HAS

BY FAR THE LARGEST CIRCULATION

OF ANY ELECTRICAL INDUSTRIAL PAPER IN GREAT BRITAIN.

ROSS COURTNEY & Co., Ltd.



Ashbrook Road, LONDON, N.

SCREWS, TERMINALS, STAMPINGS,

SMALL TURNED PARTS, &c.

PRESS TOOLS MADE FOR SPECIAL JOBS.

Quotations on receipt of requirements.

Mr. J. G. LORRAIN, M.I.E.E., M.I.M.E., &c.

Fellow of the Chartered Institute of Patent Agents.

Norfolk House, Norfolk St., London, W.C.

"PATENTEE'S HANDBOOK." Post Free on Application. 118

THE STIRLING BOILER CO., Ltd.,

2, ST. ANDREW SQUARE, EDINBURGH.

See Illustrated Advertisement last week.

Royal Doulton Potteries.

PLUMBAGO CRUCIBLES

For Melting

Brass, Copper, Malleable Iron, Steel, Antimony, Gold, Silver, &c.

Depôts:

LIVERPOOL, MANCHESTER, BIRMINGHAM, St. HELENS, Lancs., & PARIS.

DOULTON & CO., Limited,

LAMBETH, LONDON, S.E.

GENERATORS, MOTORS, &c.

Telegrams: "Drehstrom," London.

LAHMEYER ELECTRICAL CO., LIMITED,

109—111, New Oxford Street London, W.C.

Telephone 2822 Gerrard.

See Advertisement in last issue, page Sup. 20.

INSTRUMENTS AND PLANT TESTED.

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FROM

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PATRONAGE.

The Second International Tramways and Light Railways Exhibition is promoted by "THE TRAMWAY AND RAILWAY WORLD," under distinguished patronage, including: The Lord Mayors of Birmingham, Dublin, Leeds, Liverpool, Manchester, Sheffield, The Lord Provosts of Edinburgh and Glasgow, The Chairman of the London County Council, The Mayors of other Principal Towns, The Chairmen of the Principal Corporation Tramway Committees and Tramway Companies, and the Tramways and Light Railways Association.

OPENING.

The Exhibition will be formally opened for private view only at noon on Monday, June 30th, by the Right Hon. Gerald Balfour, President of the Board of Trade.

The Exhibition will be opened to the Public at 10 a.m. on Tuesday, July 1st, and will be open daily from 10 a.m. until Saturday, July 12th.

DEPUTATIONS FROM CORPORATION TRAMWAY DEPARTMENTS.

A number of Town Councils have appointed delegates to visit the Exhibition officially, and to report the results of their observations.

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The exhibits will include a complete Tramway Power Station, with electric cars in operation. Numerous types of Electric Cars. Specimens of Conduit Systems.

A Section of a Surface Contact Electric Traction System.

Various Electrical and other Apparatus in Motion, and, in brief, Examples of all appliances required in the Electrical Equipment of Tramways and Railways on various systems.

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CATALOGUE OF THE EXHIBITION.

A comprehensive Catalogue of the Exhibition is now in preparation, and will be ready on the day of the formal opening. It will contain succinct descriptions of all exhibits, pages for visitors' notes, and a carefully compiled classification of exhibits, enabling visitors to ascertain at a glance where any particular kind of apparatus or material is shown.

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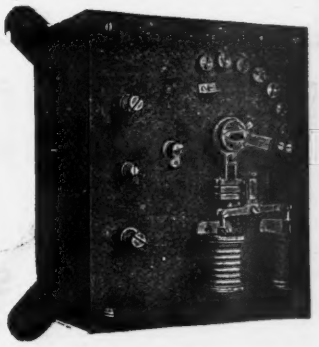
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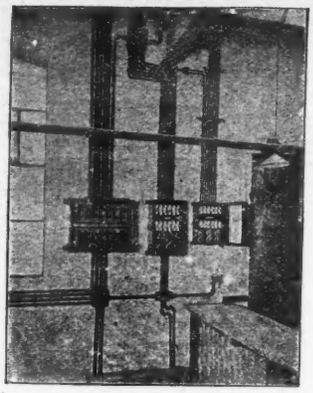

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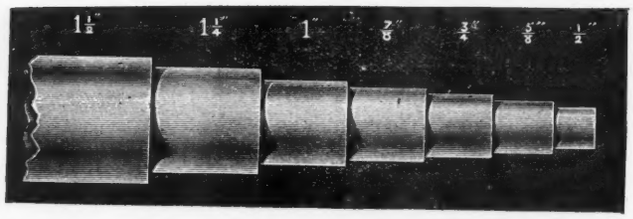

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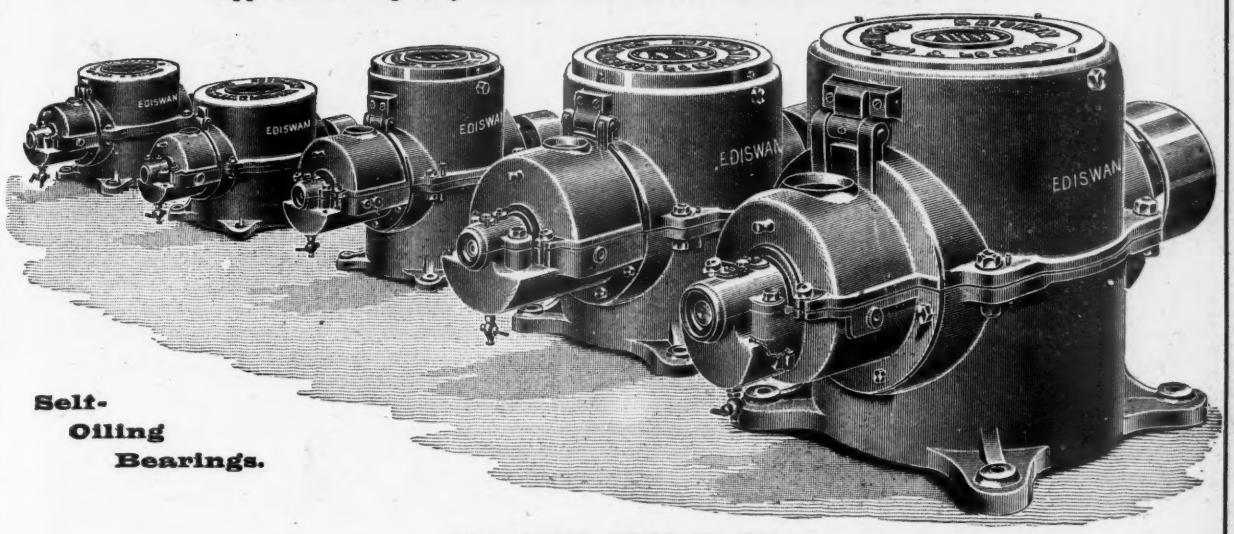

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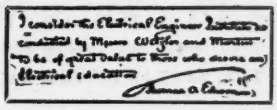

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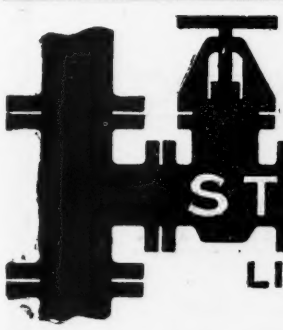

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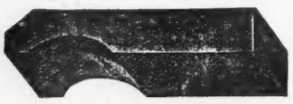

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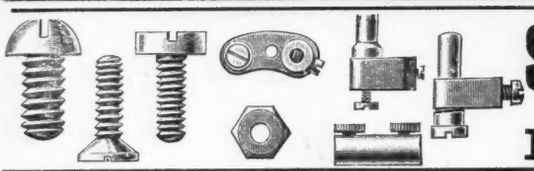

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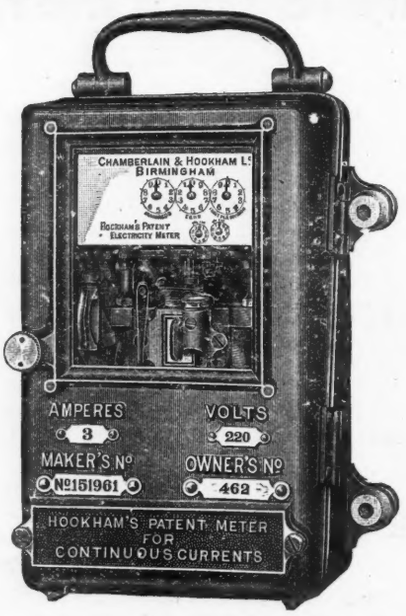

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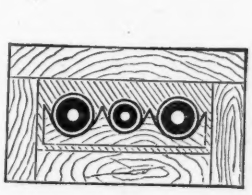

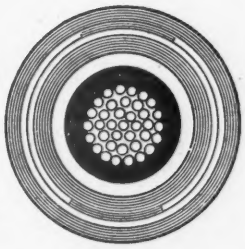

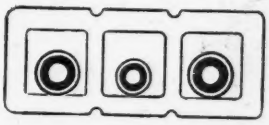

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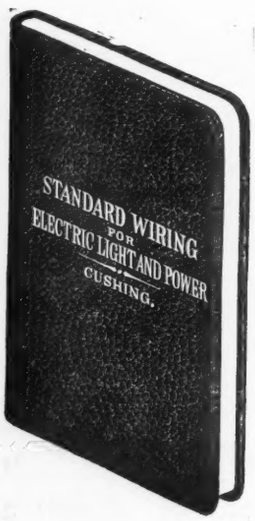

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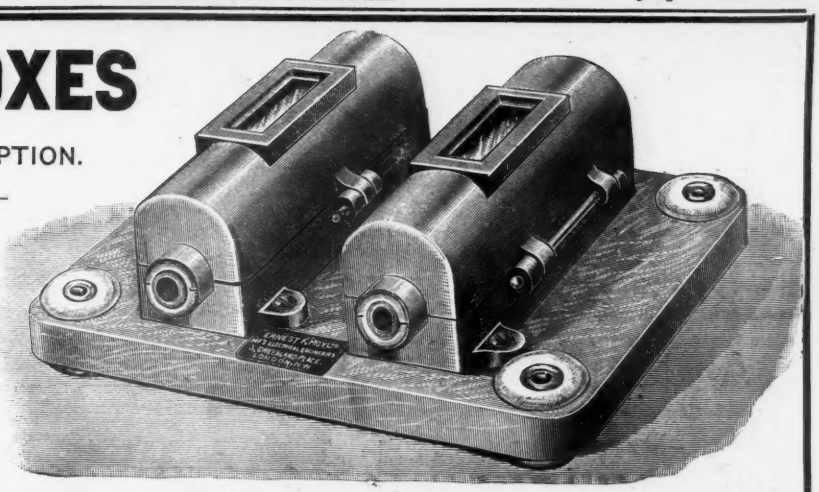

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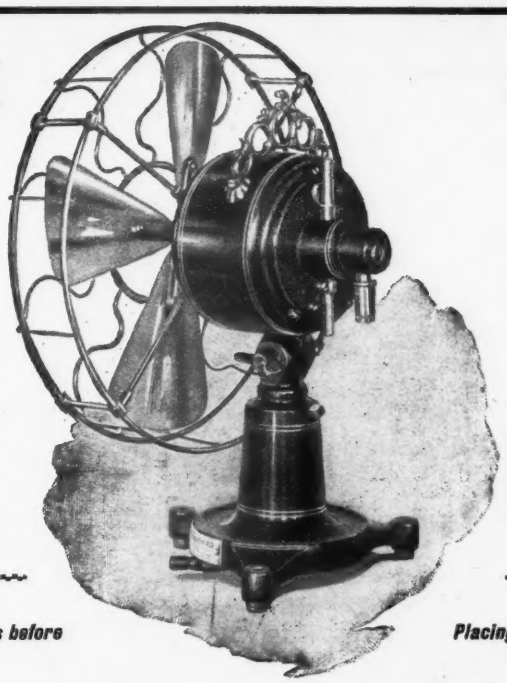

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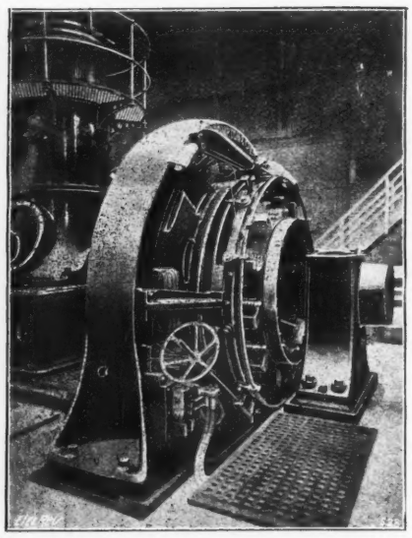

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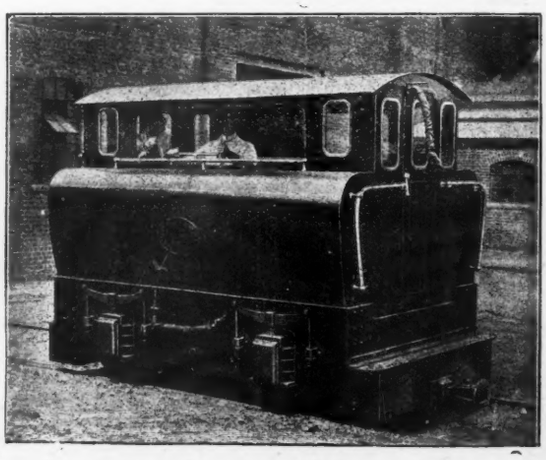

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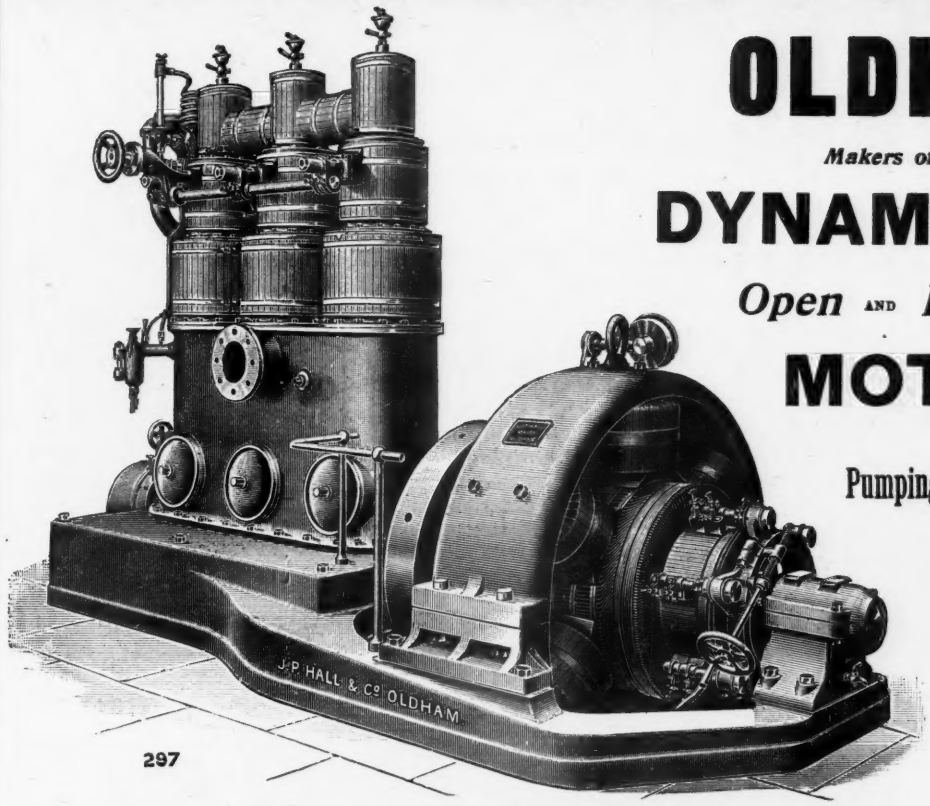

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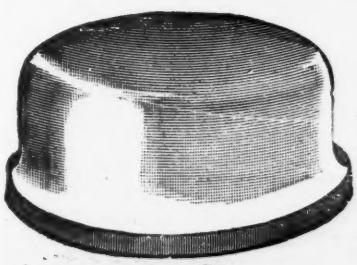
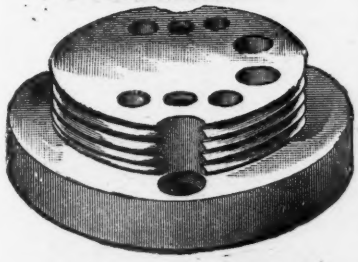
OF ALL KINDS.



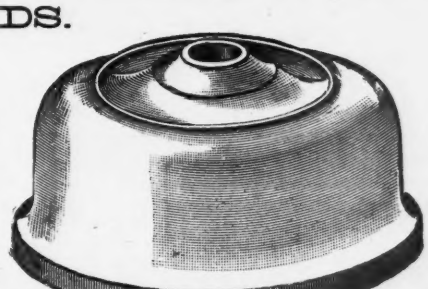


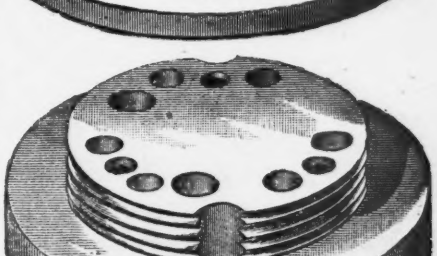
CONTRACTORS TO

M.H. POST OFFICE, INDIA, CROWN AGENTS and AGENTS-GENERAL for the Colonies, RAILWAYS and TELEPHONE COMPANIES.

MANUFACTURERS OF

PORCELAIN for Electric Light Fittings, SWITCHES, CUT-OUTS, CEILING ROSES, WALL PLUGS, D.P. CUT-OUTS, PULLEYS, TUBES, INSULATORS for Underground Mains, PORCELAIN SLABS for Main Switches, superseding enamelled Slate and Earthenware.





ALL THESE GOODS MADE IN PURE

VITREOUS PORCELAIN,

GIVING THE HIGHEST INSULATION—INDISPENSABLE FOR DAMP PLACES.

WORKS— HANLEY and TIPTON

London Office: 3, Laurence Pountney Hill, E.C.

Telephone No. 975 Bank.

J. H. TUCKER & CO.,

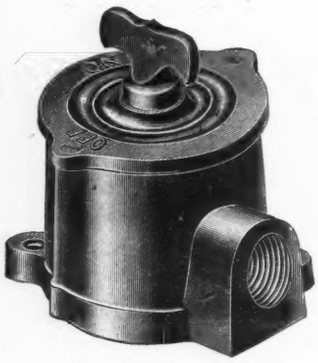
MANUFACTURERS OF ELECTRICAL ACCESSORIES.

London Depôt:
3, BURY STREET,
NEW OXFORD STREET, W.C.

Sampson Road North, BIRMINGHAM.

Telegrams:—"SWITCHES, BIRMINGHAM."

Glasgow Depôt:
71, BOTHWELL STREET.



No. 43.

IRON CASED TUMBLER SWITCHES

(PATENT).

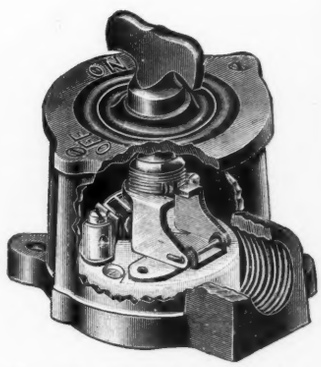
POSITIVE AND EASY ACTION.

FITTED WITH OUR No. 18 TUMBLER SWITCH.

EBONITE INSULATION.

PRICE, to carry 5 Amps.

No. 43 ... ... **6/9** each.



No. 43, Showing interior.

LARGE DISCOUNTS TO THE TRADE AND SHIPPERS.

FLUCTUATIONS in Mains, DAMAGE to MOTORS

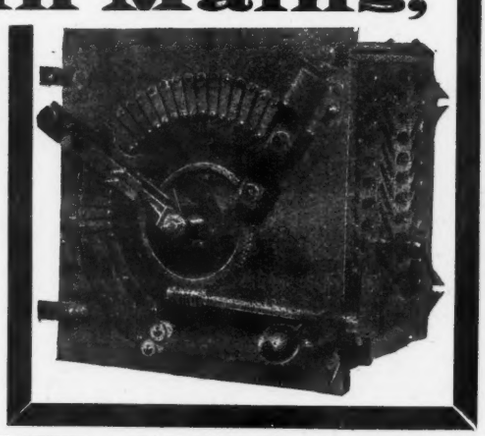
Through Careless Starting

PREVENTED.

Send for Leaflet "10 E.S.," describing our Positive Slow Gear for Starters.

STURTEVANT ENGINEERING CO., Ltd.,

147, QUEEN VICTORIA ST., LONDON.



THE

ELECTRICAL POWER STORAGE

Co., Ltd.,

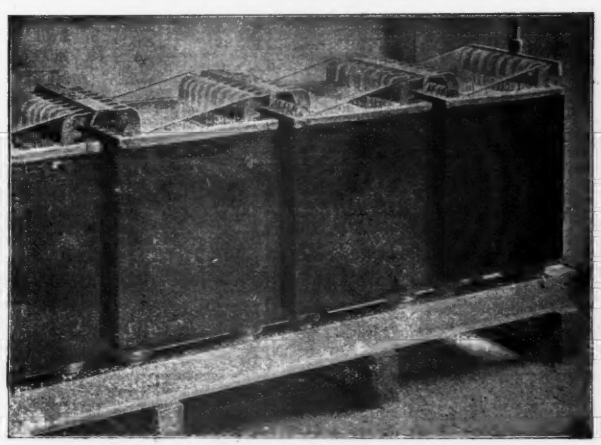
Storage Battery Makers by Royal Warrant

TO HIS MAJESTY THE KING.

P Type Cells for Traction with Automatic Reversible Booster as supplied to the Corporations of Birkenhead Yarmouth.

P TYPE CELLS FOR LARGE POWER AND LIGHTING STATIONS AS SUPPLIED TO:—

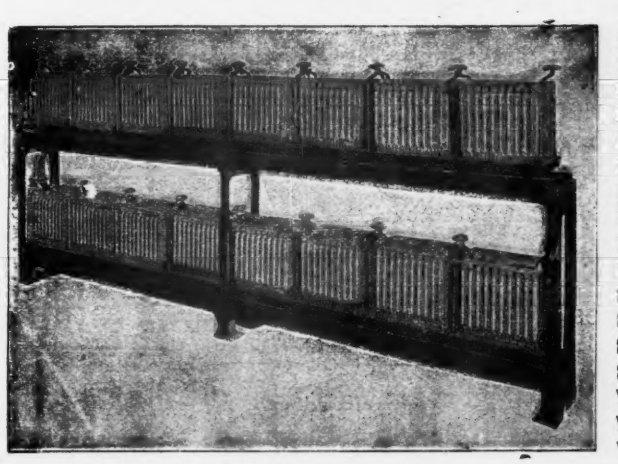
Aberdeen Corporation
Ayr „
Belfast
Birkenhead
Birmingham „
Blackburn
Bradford
Bristol „
British Electric Plant Co.
Cleckheaton District Council
Crystal Palace Electric Supply Co.
Dublin Corporation
Dundee „
Electrical Power Distribution Co.
Hendon District Council
Hornsey „ „
Hotel Majestic



Ilford District Council
Lancashire & Yorkshire Ry. Co.
Leith Corporation
Liverpool „
Liverpool Overhead Railway
London County Council
Metropolitan Electric Supply Co.
Midland Electric Light & Power Co.
Midland Railway Co.
Newcastle-on-Tyne Corporation
Norwich Electric Supply Co.
Nottingham Corporation
Prince of Wales Hotel, Harrogate
Richmond Light & Power Co.
Whitehaven Corporation
Yarmouth „
And many others.

WS TYPE FOR SMALL LIGHTING STATIONS, PRIVATE HOUSES, &c., &c., AS SUPPLIED TO:—

Aberdeen Corporation
Barking District Council
Barnes „ „
Belfast Corporation
Birkenhead Corporation
Bradford Workhouse
Bury Corporation
Bury St. Edmund's Corporation
Carlisle Corporation
Chester „
Colchester „
Crystal Palace Electric Supply Co.
Doncaster Corporation
Empire Hotel, Buxton
Empire Hotel, Lowestoft
Gloucester Corporation
Harrogate Hydro
Harrow Elec. Light & Power Co.
Horsham District Council

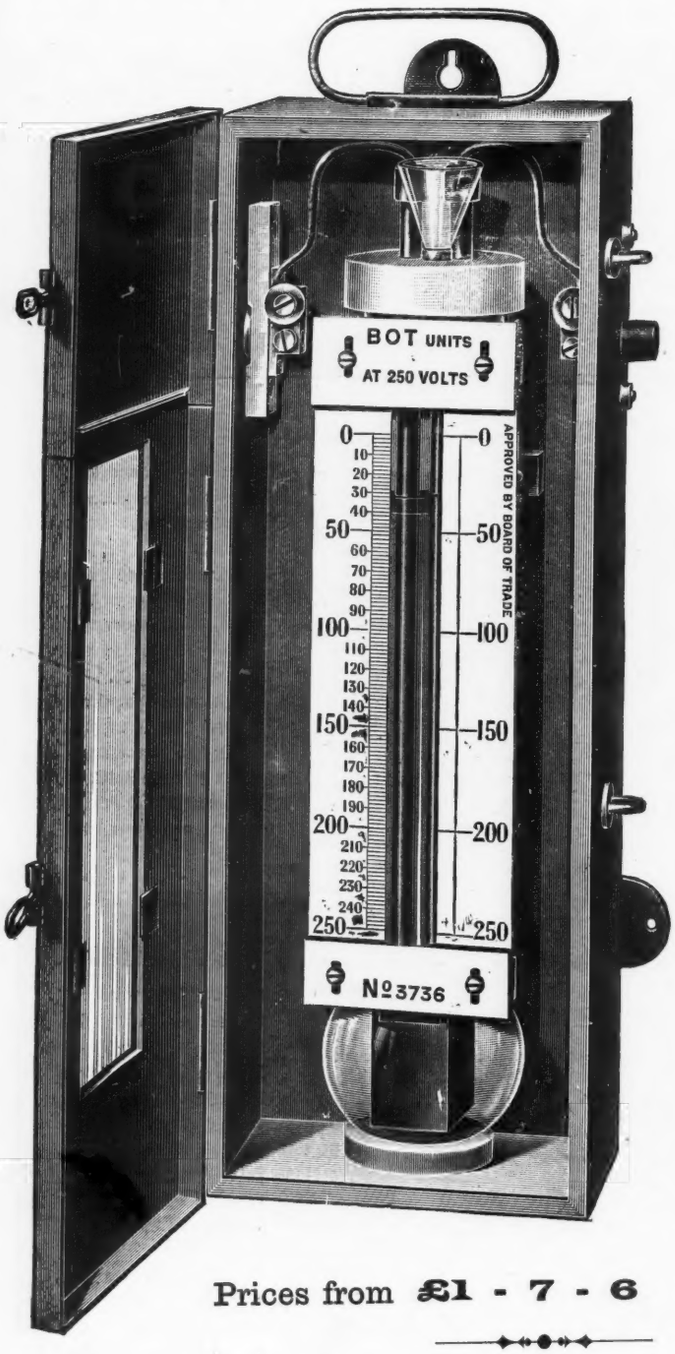


Liverpool Corporation
Liverpool and District Supply Co.
Midland Electric Light & Power Co.
Morecambe District Council
Motherwell Corporation
Nottingham „
Oxford Electric Supply Co.
Perth Corporation
Rochdale Workhouse
Rotherham Corporation
Royal Mint
Sleaford Corporation
Stockport „
Sunderland „
Sutton Coldfield Corporation
Walsall Corporation
War Office
Worksop District Council
And many others.

4, GREAT WINCHESTER STREET, LONDON, E.C.

ESTABLISHED 1882.

BASTIAN METERS.



Prices from **£1 - 7 - 6**

A WELL-KNOWN CORPORATION ENGINEER WRITES:

"In some cases I have replaced other meters by those of your make, and the returns show that the daily average consumption is increased; due, no doubt, to the accuracy of the meter with very small currents."

Here's an Eye-Opener FOR Central Station Engineers.

Electrolytic versus Motor Meters.

In an article on **200 volt supply** appearing in the "Electrical Times," May 15th, 1902, it is stated that at least **10 per cent.** of your gross revenue gets away because your cheap motor meters do not record the **minute fractional loads** which exist during many hours of the day and night.

Bastian Meters always record the smallest currents, and will increase your revenue

Ten per cent.

THE BASTIAN METER COMPANY, Ltd.,

BARTHOLOMEW WORKS KENTISH TOWN, LONDON, N.W.

Telephone 478 King's Cross.
Telegrams: "Truepenny, London."

Westminster Office:
HAYDN HARRISON & CO.,
11, Victoria Street, S.W.

ALLEY & MACLELLAN

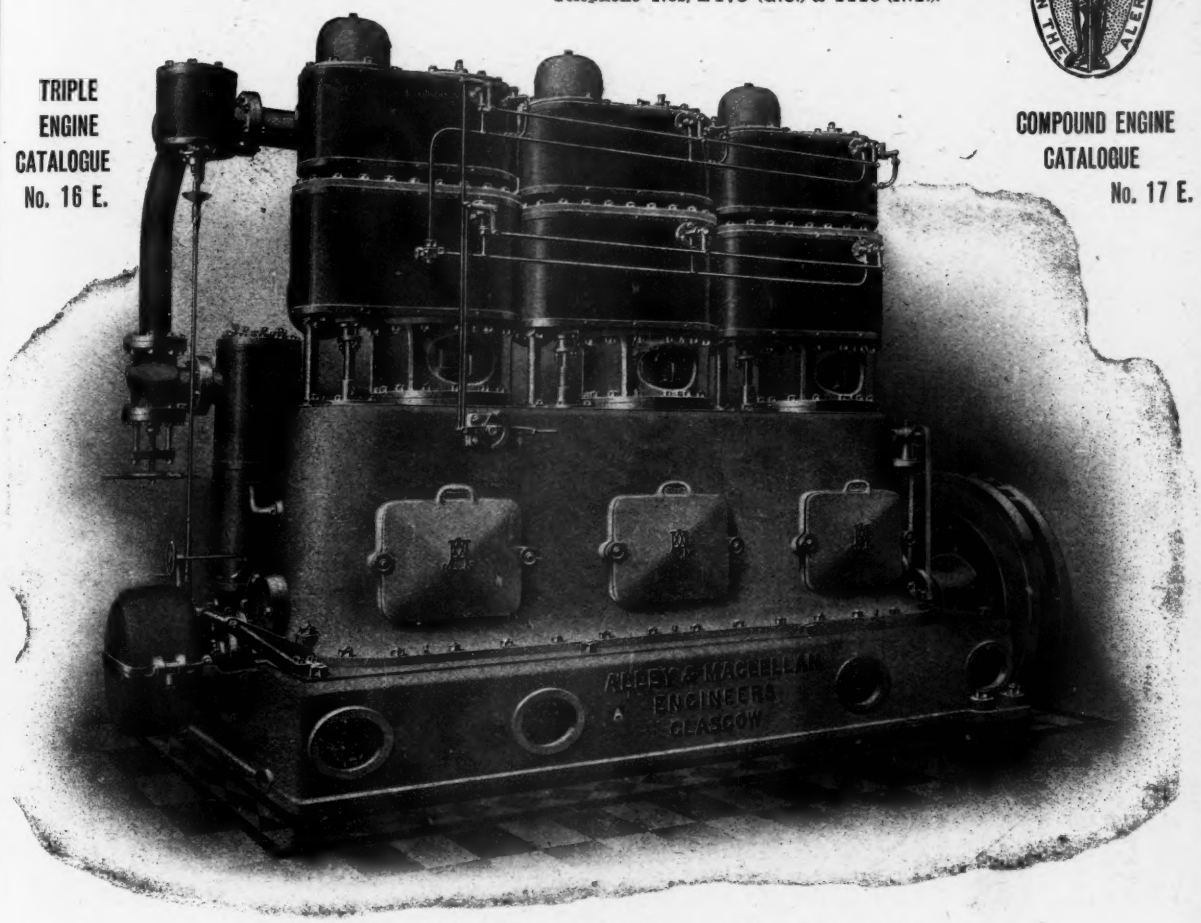
ENGINEERS,

GLASGOW.

Telegrams: ALLEY, GLASGOW.
Telephone Nos. Z 173 (G.C.) & 4446 (N.T.).

TRIPLE ENGINE CATALOGUE No. 16 E.

COMPOUND ENGINE CATALOGUE No. 17 E.



400 B.H.P. TANDEM COMPOUND "SENTINEL" ENGINE, CLASS III. G TYPE.

"SENTINEL"

High-Speed Engines.

Standard Sizes, 10 to 1500 B.H.P.

Made Simple, Compound or Triple Expansion, and either Single-Acting or Double-Acting Forced Lubrication.

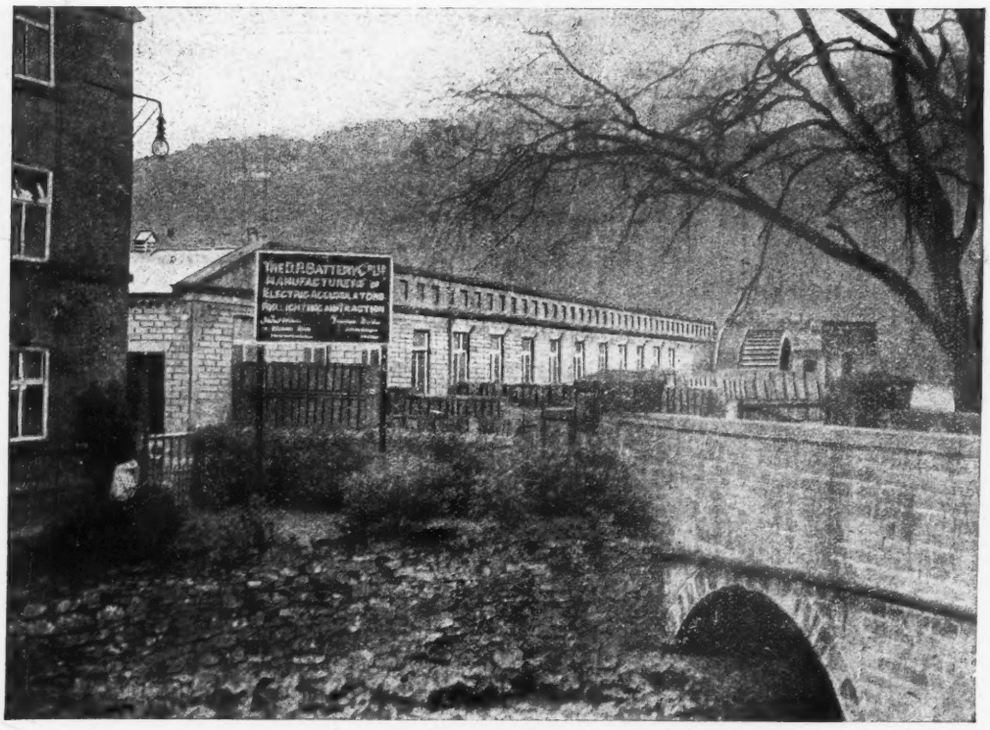
SIMPLE in Construction, ECONOMICAL in Steam and Oil, SILENT in Running, DURABLE.

OUTPUT—150 ENGINES PER ANNUM.

IMPORTANT REDUCTION IN PRICES OF

D.P. STORAGE BATTERIES.

EASY TO HANDLE. NO TROUBLE. LONG LIFE.



View of the Company's Works at Bakewell.
Water-wheels of 150 Horse-power, Marshall Condensing Engine 140 Horse-power, Willans Engine 120 Horse-power.

THE COUNTRY HOUSE ACCUMULATOR

The extensions of power having now been completed, the Company are in a position to still further increase their output, with a corresponding reduction in prices.

SEND FOR CATALOGUE.

The present plates contain many improvements which are the results of 15 years' working experience.

The D.P. BATTERY CO., Ltd.,

REGISTERED OFFICES (to which all communications should be sent):

11, Victoria Street, Westminster, London, S.W.

Telegrams:—"CUMULOSE, LONDON." *Telephone:—291, WESTMINSTER.*

Works:—Lumford Mills, Bakewell, Derbyshire.

REDUCED PRICES

IN

JANDUS LAMPS.

NOTICE: **The Jandus Company, having adopted the latest labour-saving machine tools applicable to arc lamps and by making in larger quantities, have been able to substantially reduce the prices in certain directions, notably in the Small Pattern Standard Lamp.**

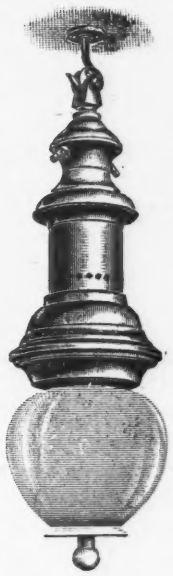
HIGH EFFICIENCY.

GOOD DIFFUSION.

JANDUS TRIMMING DEVICE.

GOOD APPEARANCE.

RELIABILITY.



SMALL PATTERN STANDARD.

Specification:

Length: 29 INCHES.

Globe: 9 INCHES.

Average Life: } 100 HOURS.

Current: 4 AMPS.

Guarantee: 12 MONTHS.

Price: ***£4 10s.***

to Trade Only.

SEND FOR PARTICULARS TO SOLE AGENTS FOR THE

JANDUS ARC LAMP & ELECTRIC CO., Ltd.,

DRAKE & GORHAM, Ltd.,

66, VICTORIA STREET, WESTMINSTER, S.W.

Telegrams: "Accumulator, London." Telephone: 898 and 71 Westminster.

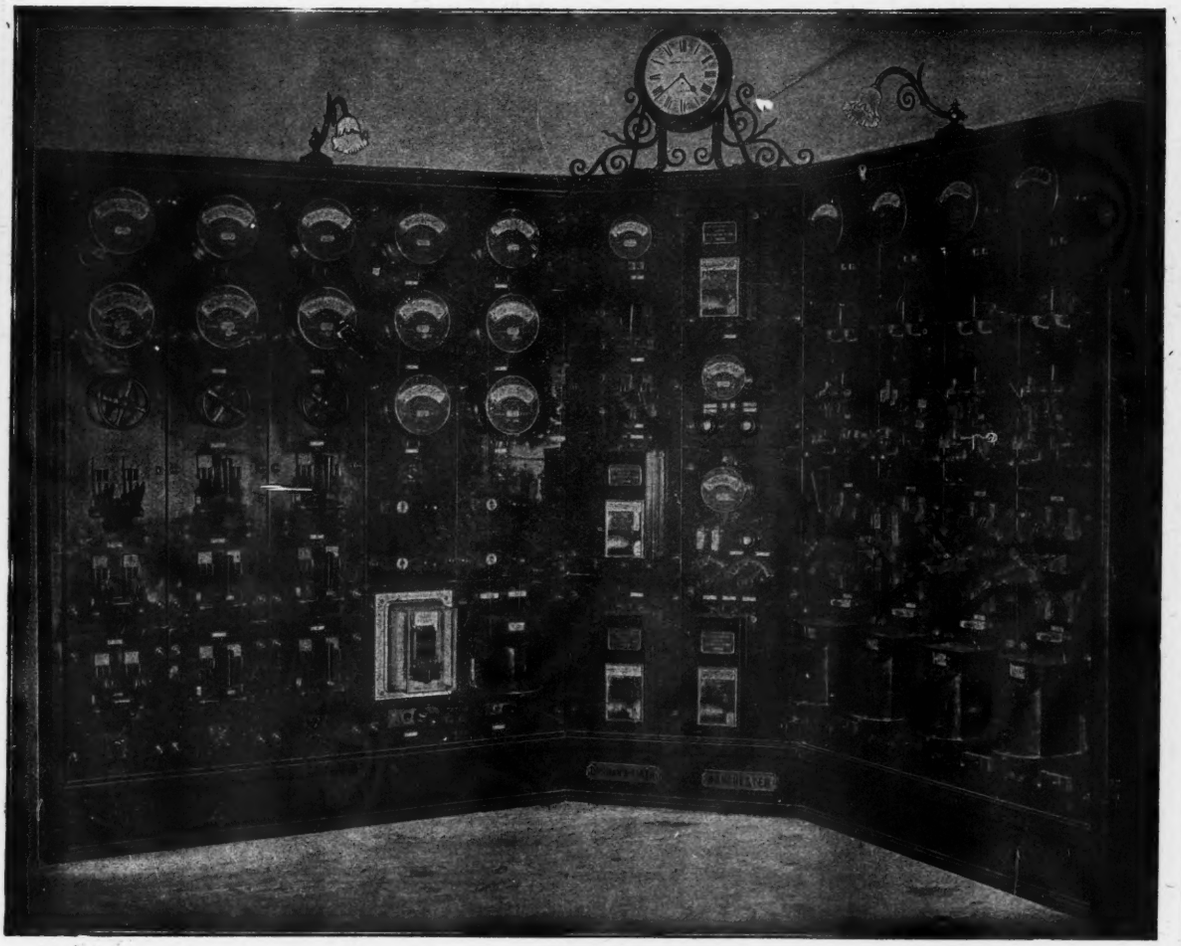
Also 47, Spring Gardens, MANCHESTER; Baltic Chambers, 50, Wellington Street, GLASGOW; and Westminster Chambers, East Parade, LEEDS.

Sub-Agents for the North:—
ROBERT BOWRAN & CO.
3, St. Nicholas Buildings,
Newcastle-on-Tyne.
Telegrams:—
"Bowran, Newcastle."

Sub-Agents for the Midlands:—
THE ELECTRICAL TRADES SUPPLY, Ltd.,
Cornwall Buildings,
Cornwall St., Birmingham.
Telegrams:—
"Motors, Birmingham."

D. TRACTION & LIGHTING S.

MAIN SWITCHBOARDS.



TRACTION SWITCHBOARD BY DORMAN & SMITH.
FITTED WITH D. & S. PATENT CIRCUIT BREAKERS.

Central Station Switchboards recently built or now building by them

ASHTON-UNDER-LYNE. Traction and Lighting.
LEIGH. Lighting.
SOUTHPORT. Traction.
PEMBERTON. Lighting.
BLYTH. Lighting.
SPENNYMOOR. Lighting.
DARWEN. Traction.
WIGAN. Traction and Lighting.
DEWSBURY. Lighting.
NELSON. Traction and Lighting.
DONCASTER. Traction.
CLECKHEATON. Traction and Lighting.

And several others **MADE FOR INTERMEDIATE CONTRACTORS**

DORMAN & SMITH,

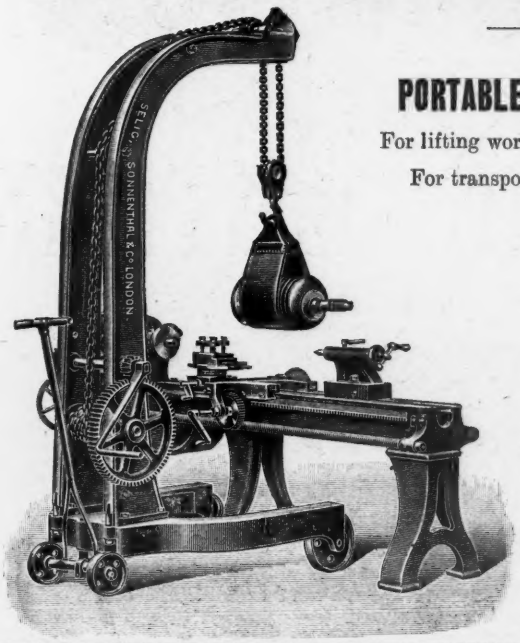
First Hand Manufacturers

Of Controlling Gear and Accessories for Electric Light and Power Installations as specified by many of the Leading Consulting Engineers and as used by the Principal Contractors at Home and Abroad.

LONDON OFFICE:
94, Charing Cross Road, W.C.

HEAD OFFICE & WORKS:
Ordsal Electrical Works Salford, MANCHESTER.

SELIG, SONNENTHAL & CO.



PORTABLE CRANES AND HOISTS.

For lifting work on and off machine tools, &c.

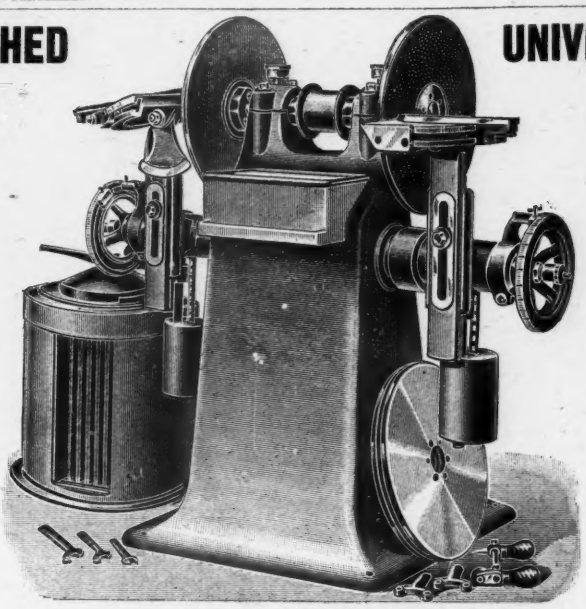
For transporting heavy pieces about the shop, &c., &c.

These cranes are actually tested to the full load before being sent out.

HIGHLY FINISHED GRINDING

For Finishing Plain Surfaces and Segments of Cylindrical Surfaces Rapidly and Accurately either of Steel, Iron, Brass, Copper, &c.

They are also supplied with PLAIN Table instead of Universal (as illustrated), for work on which no fixed dimensions are required,



UNIVERSAL & PLAIN MACHINES

(Mechanical Fitters)

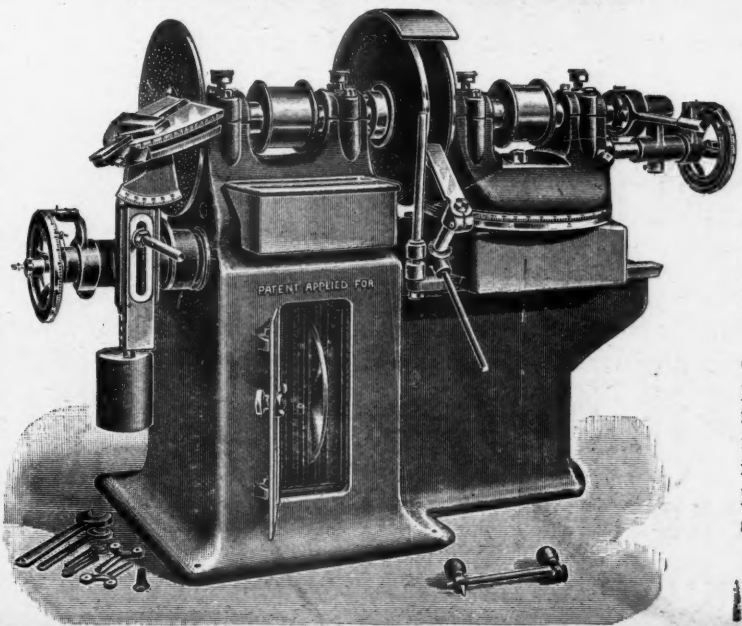
These machines are guaranteed equal in accuracy, finish, and materials with the best class of Machine Tools built.

or with EMERY RINGS in place of Steel Discs for cast-iron, and for removing considerable stock.

ALSO WITH

ELECTRIC MOTOR.

The Double Head Machines will finish two sides of an object at once, such as cold pressed hexagon nuts, sides and ends of locks, lock cases, hinges, &c., &c., and are recommended for the most accurate work, doing same in about two-thirds of the time occupied by the single disc.



The Discs will admit 12″ between, the adjustable one having a lateral motion or feed of 1″, same being controlled by lever shown at end of arbor.

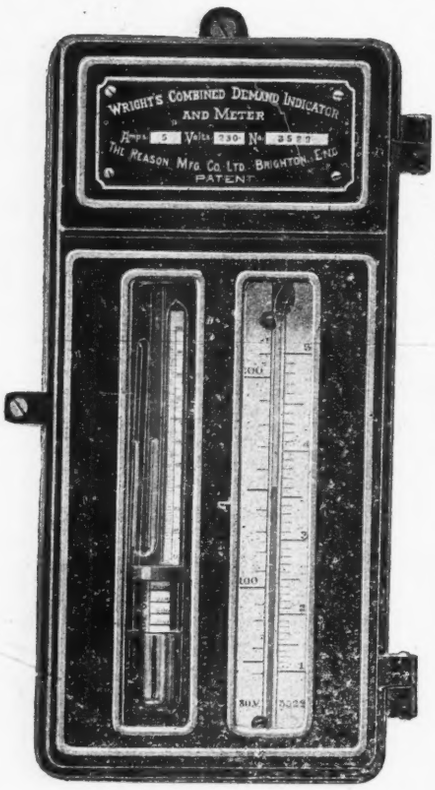
These machines can be fitted with a pair of Emery Rings in place of the discs for finishing cast-iron parts, hot forged hexagon nuts and similar work.

85, Queen Victoria Street, E.C., LONDON, and Lambeth Hill, E.C.

A REFORMATION

IN

ELECTROLYTIC METERS



Combining the

SIMPLICITY,

ACCURACY

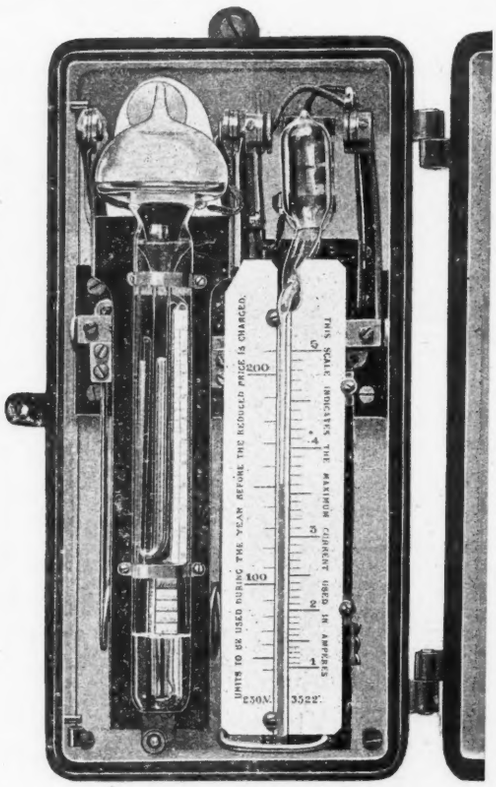
and

CLEANLINESS

of a Thermometer with the

CHEAPNESS

of a Gas Meter.


THIS SCALE INDICATES THE MAXIMUM CURRENT USED IN AMPERES
UNITS TO BE USED DURING THE YEAR BEFORE THE REQUIRED PRICE IS CHARGED.
200
100
250V.
3522

It registers accurately at all loads from $\frac{1}{100}$th of an ampere.

Maximum drop less than 1 volt.

Only one size necessary up to 10 amperes.

Small wall space required.

Portable, Hermetically sealed, and cannot get out of order.

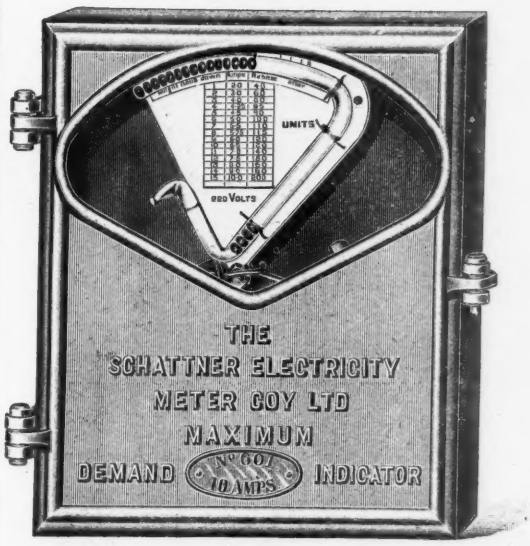
If you have the Demand Indicator System of Charging, you should employ our Combined Instrument. It is convenient, minimises Pressure Loss, and simplifies Wiring.

Send for Quotations to:—

THE REASON MANUFACTURING CO., LTD.,

BRIGHTON.

THE ATKINSON-SCHATTNER DEMAND INDICATOR.

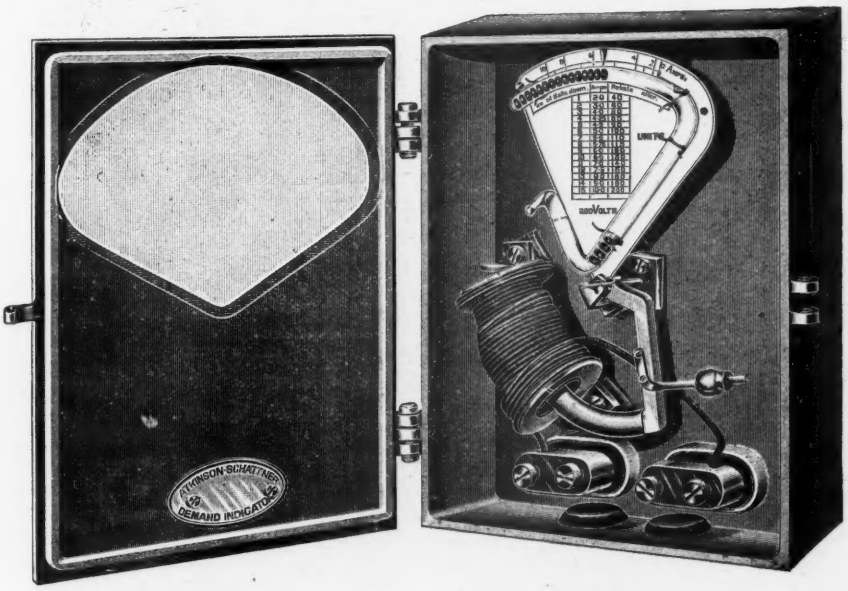


A Reliable and
Accurate,
Instrument.

Suitable for both Alternating and Continuous Current Circuits.

INEXPENSIVE, - -
- SIMPLE,
- - COMPACT.

CANNOT GET OUT OF ORDER.



Already
Adopted by many
LONDON
and
PROVINCIAL
Supply
Stations.

Also by
South African
and
American Stations.

FOR FURTHER PARTICULARS APPLY TO—

THE SCHATTNER ELECTRICITY METER CO., Ltd.,

Tyndale Works, Upper Street, LONDON, N.

ALSO MAKERS OF LONG-SCHATTNER PREPAYMENT METERS.

THE ONLY PREPAYMENT METERS APPROVED BY THE BOARD OF TRADE.

IRON-CLAD MOTORS

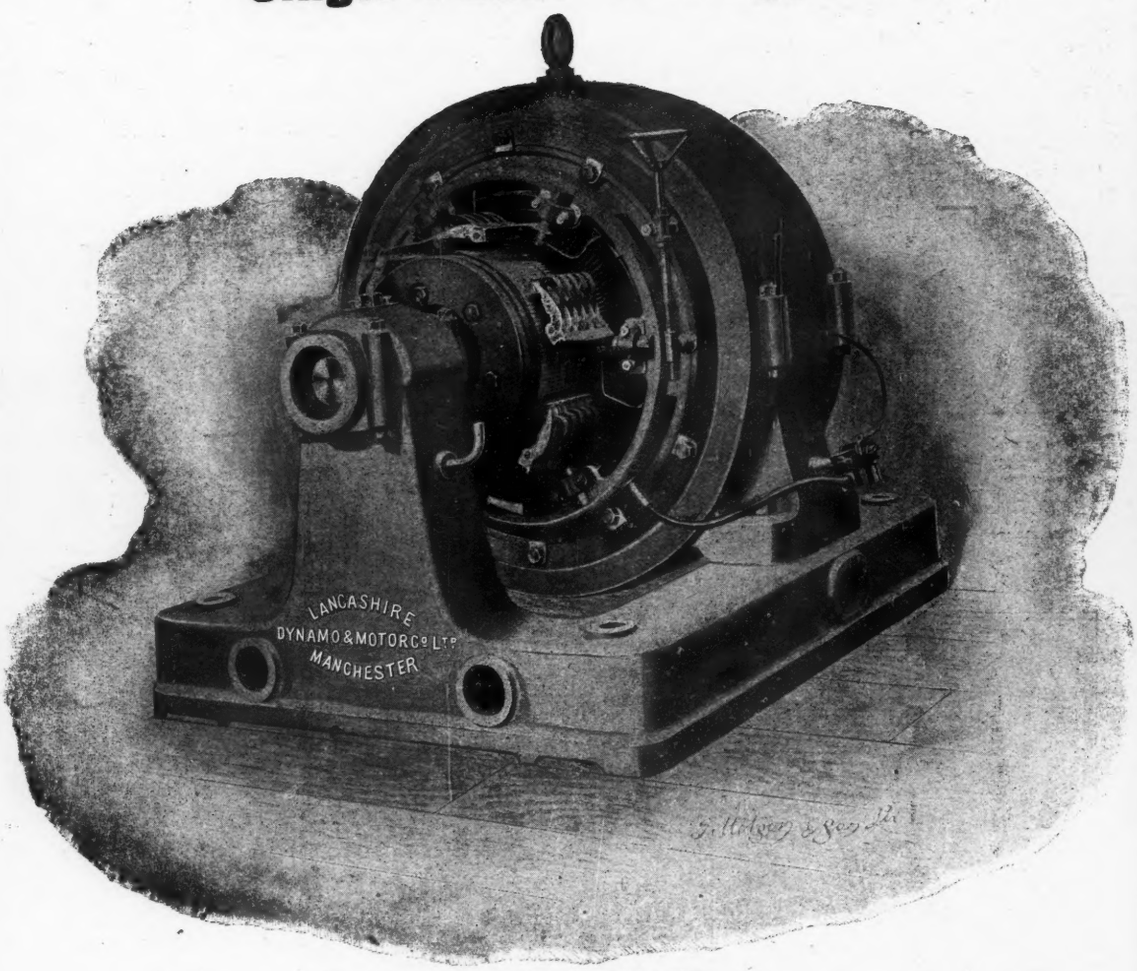
Dust-Proof or Ventilated, All Sizes.

DIRECT CURRENT DYNAMOS

For Belt Driving or Direct Coupling.

ALTERNATORS

Single-Phase or Polyphase.



MULTIPOLAR DYNAMO.

RECENT GLASGOW EXHIBITION.

200-KW., 5000-volt three-phase Alternator coupled direct to Hick Hargreaves Engine. 75-KW. Motor Generator: 5000-volt. synchronous alternating Motor, 500-volt D.C. Generator supplying Exhibition mains. Both above sets for sale.

Multipolar Generators for direct coupling, as supplied to, or on order for, the following Corporations:—Accrington, Farnworth, Lowestoft, Motherwell, Rhyl, Wallasey, Wrexham, Long Eaton and Gravesend, and many manufacturing firms.
Dynamos and Motors up to 100 H.P. made to stock in large quantities, interchangeability guaranteed. Catalogue on application.

THE LANCASHIRE DYNAMO & MOTOR CO., Ltd.,

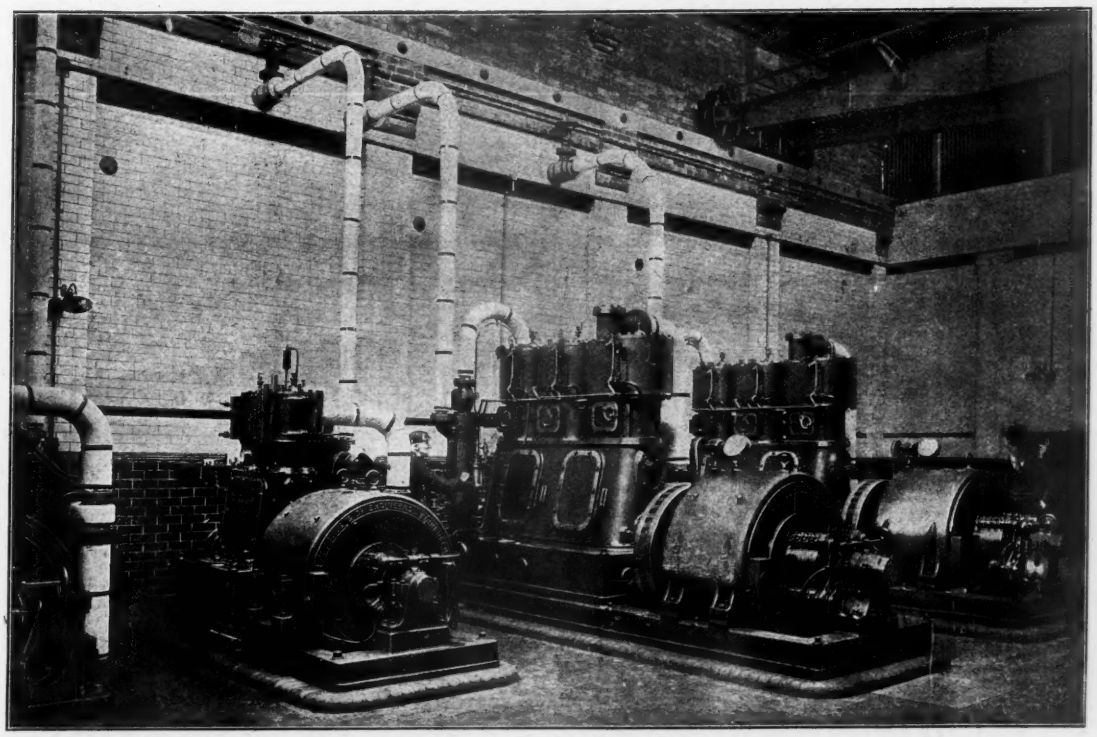
Offices and Works: Trafford Park, Manchester.

Telegrams: "IRONCLAD, MANCHESTER."

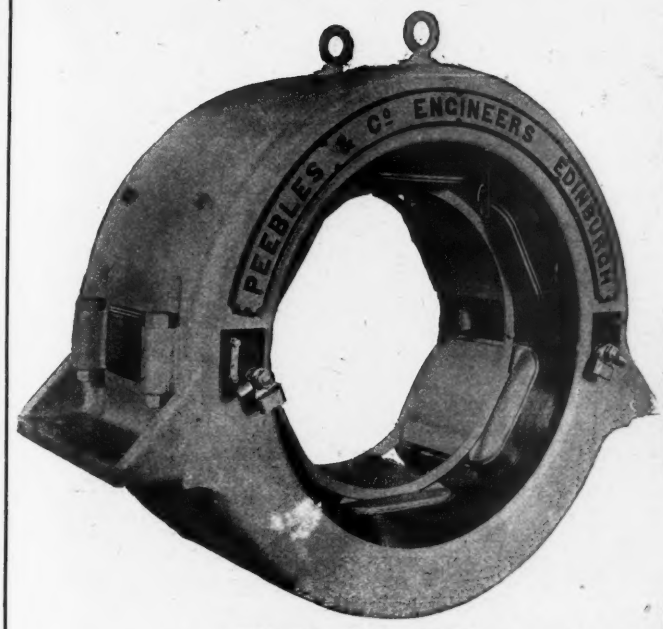
D. BRUCE PEEBLES & CO.,

Offices :—London—39, VICTORIA STREET, WESTMINSTER, S.W.
Glasgow—LOUDEN BROS., 39, WEST CAMPBELL STREET.
Cardiff—ROYAL CHAMBERS, PARK PLACE.
Newcastle—13, WESTGATE ROAD.

TAY WORKS, EDINBURGH.



PARTICK CENTRAL STATION.

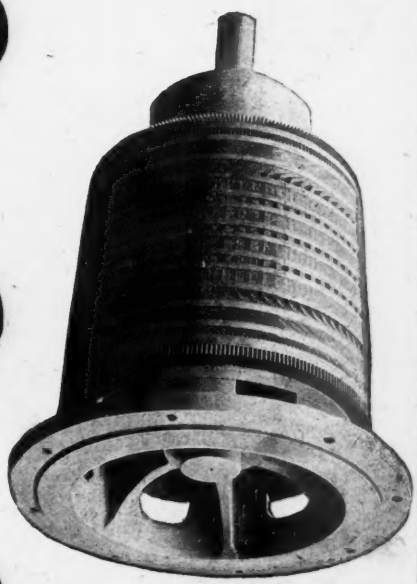


350 Kw. P.P.P. CASE.

P.

P.

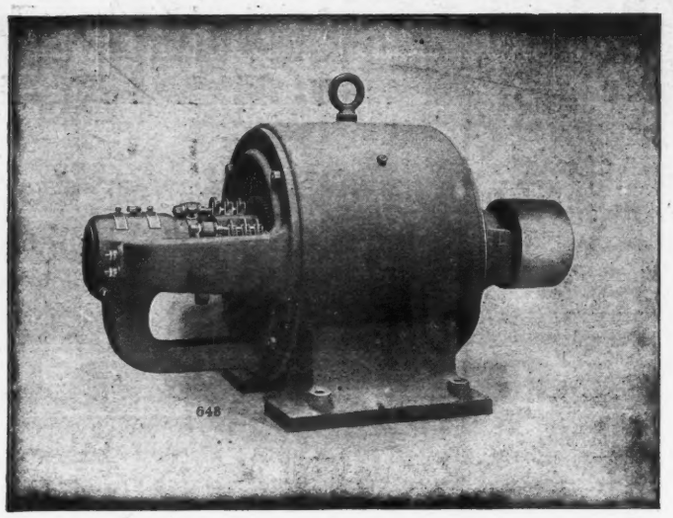
P.



350 Kw. ARMATURE.

100 CENTRAL STATIONS

Eqipped with P.P.P. Plant.



The Illustration shows one of our

SELF-CONTAINED

MOTORS,

which we make in sizes from 2 to 60 H.P.

NEW LIST NOW READY.

Dynamos.	Hauling.
Motors.	Winding.
Fans.	Coal Cutting.
Pumps.	Lighting.
Engines.	Pumping.
Cranes.	Drilling.

ERNEST SCOTT & MOUNTAIN, Ltd.,

Electric Light & Power Engineers, NEWCASTLE-ON-TYNE.

Telegraphic Address:—"Esco, Newcastle-on-Tyne." *London Office:*—20, New Bridge Street, Blackfriars.

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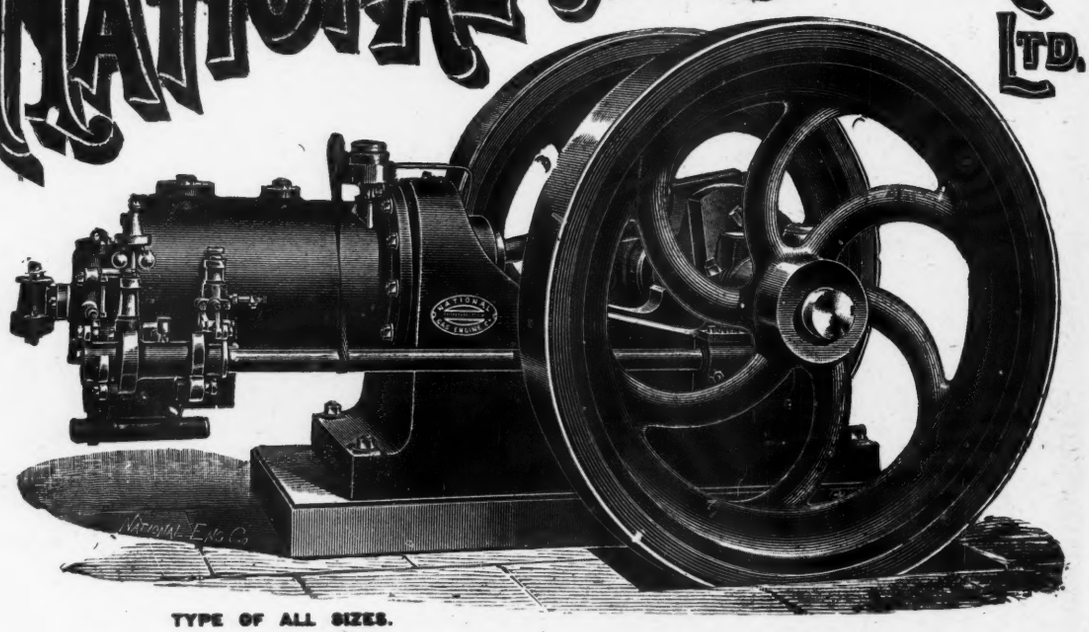

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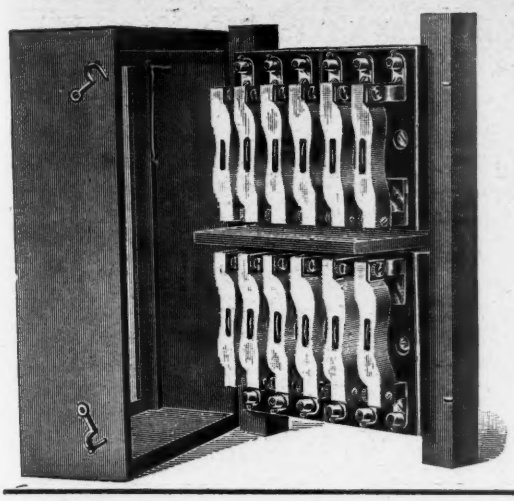

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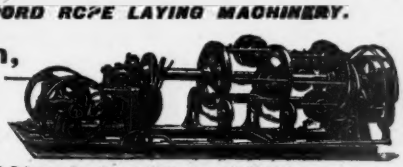

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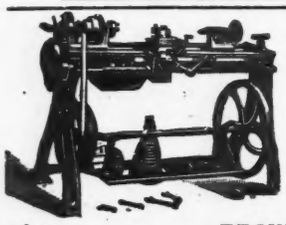

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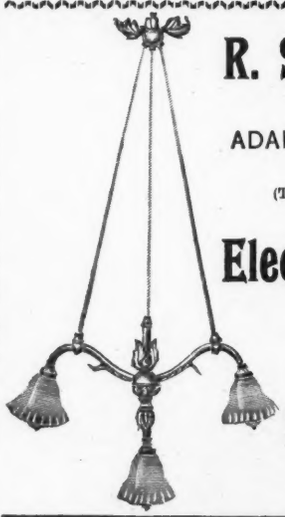

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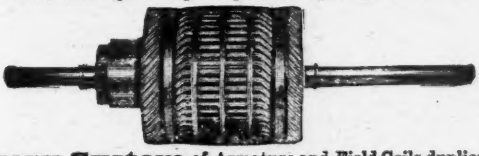

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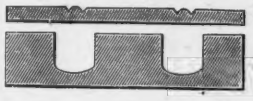

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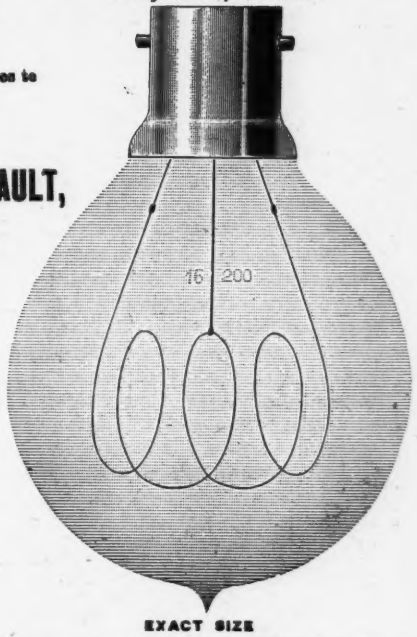

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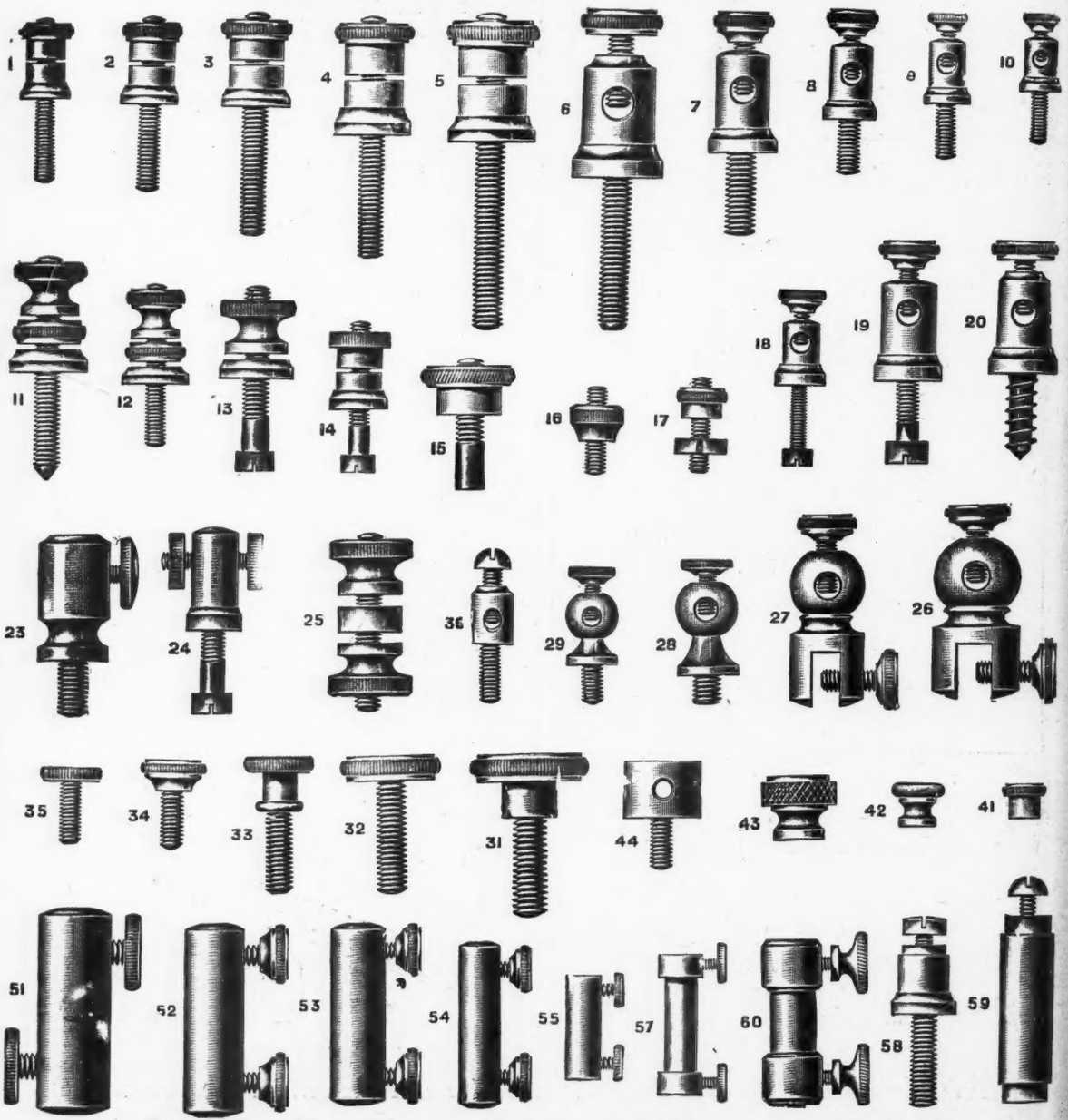

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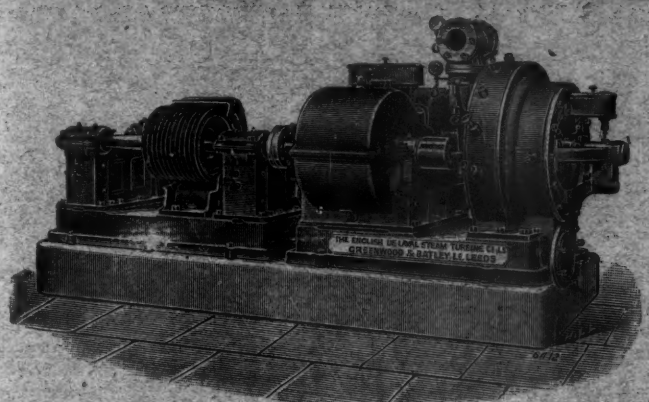

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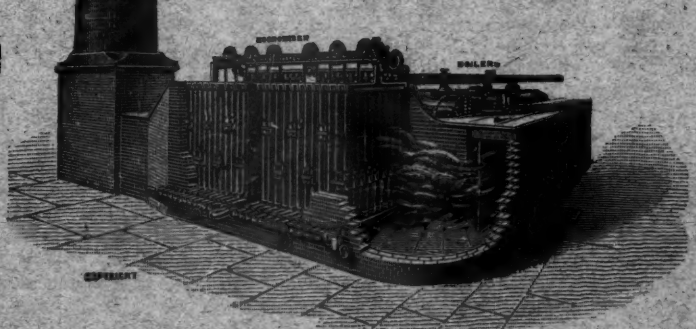

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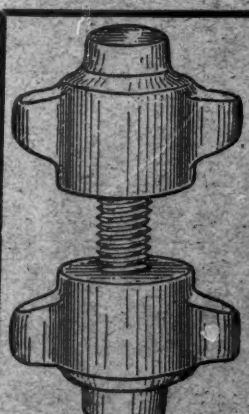

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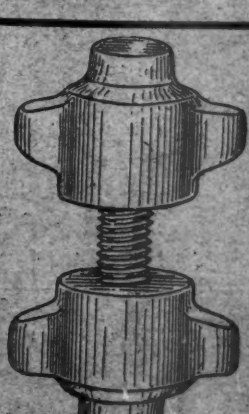

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